

LONG PRODUCT SORTING SYSTEM ✓

FIELD OF THE INVENTION

The present invention relates to a long-product sorting system. In particular, the present invention pertains to a system for sorting in-between-length and
5 remnant long-products efficiently and automatically.

BACKGROUND OF THE INVENTION

It is well known in long product rolling mills and downstream fabrication of bars that odd-length long products are generated. Traditionally,
10 such long products are either recycled to the melt shop as scrap or sorted manually and grouped according to length. The recycling process is inefficient while the manual sorting process is time consuming and labor intensive.

OBJECT OF THE INVENTION

It is an object of the present invention to sort odd length bars and long products automatically to the closest predetermined stock length.

It is another object of the present invention to reduce the labor input in long
5 product sorting operation.

It is yet another object of the present invention to modularize long product sorting system whose length resolution of sorted long products is adjustable.

SUMMARY OF THE INVENTION

The present invention is a long product sorting system featuring a measuring unit having measuring means for ascertaining the length of each long product, and transferring means for transferring onward the measured long product. This system also comprises at least one receiving section having multiple receiving means. Each receiving section comprises a plurality of receiving means for receiving thereacross measured long products of similar length, each receiving means provided with covering means having an open and a close position. When all the covering means of one receiving section are closed, they form a continuous sloped surface along the receiving section such that a measured long product received from the measuring unit can gravitate laterally from the top of one receiving means to the top of the next receiving means. The system measures the length of the long product using the measuring means, and identifies one receiving means which is designated to store products of a similar length. The system opens the covering means of the designated receiving means, such that as the long product is transferred laterally off from the measuring unit by the transferring means, the long product would gravitate over the sloped surface and drop into the opened designated receiving means.

In the specific embodiment of the present invention, the receiving section is a bins section and the receiving means is a bin. The covering means is a lever assembly, and the measuring means and transferring means are arrays of measuring sensors and pushers respectively. Each bins section comprises a predetermined number of elongated bins aligned in parallel with the measuring unit. Long products to be sorted are directed one by one to the measuring unit where an array of measuring sensors is mounted for determining the length of each product. Once the length of a

product is detected, it is ejected by an array of pushers located adjacent to the array of sensors onto the bins section. Each bin has a retractable lever serving not only as a cover for the bin if the sorted product is not designated for that bin, but also as a trap for capturing a sorted product when it is
5 designated for that bin.

In another embodiment of the present invention, a conveyor module is provided. The conveyor module has a conveyor and possibly one or more secondary conveyor sections. The conveyor is aligned lengthwise between the measuring unit and a bins section. On the conveyor, one or more
10 stopping means are incorporated to stop and position the product accurately in the conveying direction before unloading means is used to unload the product onto the bins section. The secondary conveyor provides the means for transferring the product to proximate secondary bins sections. Depending on the measured length, the product would either be transferred immediate to
15 a primary bins section or transferred to secondary bins sections before being unloaded into the designated bin. A computerized control system is used to control and synchronize the operation to achieve the maximum efficiency. In another embodiment, the operation steps of loading, measuring, conveying and unloading are overlapped such that a number of products are
20 in the system concurrently but at different stages of processing.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is the top plan elevational view of an embodiment of the present invention.

FIGS. 2A and B are front and right side views respectively of the measuring
5 table of the long product sorting system of the present invention.

FIGS. 3A and 3B are front elevational views of the conveyor assembly of the long product sorting system.

FIG. 3C is the right side, cross sectional view of the stopper and kicker assemblies of the conveyor assembly according to section A - A in FIG. 3B

10 FIG 4A is a front elevational view of the extended conveyor assembly of the long product sorting system of the present invention.

FIG. 4B is the right side, cross sectional view of the stopper and kicker assembly according to section B - B of the extended conveyor assembly.

FIG. 5A is a top plan view of the bin of the present invention.

15 FIG. 5B is an enlarged view of one frame of a bins section.

FIG. 5C is the right cross-sectional view of the bins section of the present invention according to section C - C in FIG. 5A.

FIG. 6 is the right side plan view of the dual bins of the extended conveyor assembly of the present invention.

20 FIGS 7A and 7B are flowcharts illustrating the logic of a controller for the long product sorting system of the present invention.

DESCRIPTION OF THE EMBODIMENT OF THE INVENTION

The present invention is a method and apparatus for sorting long products of varying lengths automatically. The system features various functional modules. The first module functions to measure the length of the product to be sorted. One embodiment of this module includes a sorting table having a sorting area and a measuring unit. The second module functions to transfer the measured product to the proximity of the correct storage bin. One embodiment of this second module is a conveyor system. The third module includes a group of storage bins disposed in parallel to the conveyor, the bins in each group having descending heights to utilize gravity as the moving force for the product to roll or slide down along the bin covers. A retractable bin cover or lever can be raised to allow the bin to receive the product. The system may be automated using a computer algorithm.

In the following description, numerous specific details are set forth such as mechanical parts and computer program steps, etc. in order to provide a thorough understanding of the present invention. It will be obvious to one skilled in the art that the present invention may be practiced without these specific details. In other instances, well-known parts such as those involved with the physical connection between the measuring sensors and the controller are not shown in order not to obscure the present invention.

GENERAL SYSTEM CONFIGURATION

One embodiment of the present invention is shown in Figure 1. In this example, the system includes a sorting table **20** having a sorting area **22** and a measuring unit **24**, a conveyor system **26** having a primary conveyor section **28** and secondary conveyor section **30**, three groups of bins in

sections 1, 2 and 3 (reference numerals **32**, **34** and **36**) respectively, and a control and display panel with a personal computer **38**. Another embodiment would consist of only the primary conveyor section if a small number of bins are used. Other embodiments are envisioned whereby additional conveyor
5 sections and groups of bins may be added to accommodate more types of long products of different lengths. In the embodiment given in Figure 1, the sorting area is a table. Other structures or an open area can also be used to retain the product for convenient sorting.

Referring to Figures 2A and B, the sorting table **20** includes a series of
10 measuring sensors **44** mounted on the measuring unit **24** for sensing the length of the objects put on the surface of the sorting area **22**. A set of mechanical pushers **40** are provided to transfer the measured product onto the conveyor system. In this example, the pushers **40** are located adjacent to the sensors **44** and mechanically operated with a pneumatic cylinder **42**,
15 and a guide **46**. In the preferred embodiment, an inductance proximity sensor is used. However, it is possible to use other sensors, or even contact-type limit switches to practice the present invention. The pushers may also be operated by hydraulic or electrical means. In addition, modifications within the knowledge of one of ordinary skill in the art may be made to use optical or
20 image processing methods for measurement.

Figures 3A to C show an example of the primary conveyor section **28** adjacent to the section 1 primary group of bins. The conveyor includes a stopper plate and a series of kicker plates. The stoppers or kickers are plates which are provided perpendicular to the conveying direction of the conveyor
25 system. The stopper plate aligns a product in the correct position along the conveying direction before it is "kicked" into the bin. It also functions as a gate to prevent the product in the primary conveyor from entering the secondary conveyor if the latter has a product already deposited there. The

stopper/kicker plates **48** are trapezoidal in shape, and have their upper surfaces **50** sloping downwards towards the primary bins section. In the example shown in Figures 3B and C, each stopper and kicker assembly is provided with a pneumatic cylinder **52**, kicker plate **48** and guide support **54** and conventional means for the mechanical extension of the plate. When the stopper plate is in its retracted positions, a product that is transferred to the conveyor system would travel unimpeded along the conveyor. When the stopper plate is switched to a projected position before the product arrives, then it acts as a stopper to prevent the product from moving further down the conveyor system. Then to direct the product into a suitable bin, the kicker plates located directly below that product would be switched to a projected position. As the upper surface of each plate is downward sloping, the product would be "kicked" off the conveyor system onto section 1 containing a group of bins. Figures 3A shows all the plates in the extended position.

Figure 4A shows a segment of the secondary conveyor section **30**. In this example, the secondary conveyor section as discussed above acts as a extended conveyor and is situated between the sections 2 and 3 bins sections. In order for the kicker assemblies to function bidirectionally, i.e. kicking the product either to bins section 2 on one side or bins section 3 on the other side, two sets of kicker/stoppers are required in this secondary conveyor section. One type have plates **56** with the upper surface **58** sloping downwards in one direction, and another type with plates **60** with the upper surface **62** sloping downwards in the other direction. In this embodiment, any of the plates may function as a stopper. Once the product has been stopped at the appropriate position, the correct set of kickers are raised to "kick" the product to the correct bins section.

The bins sections according to one embodiment of the present invention comprises a plurality of elongated bins aligned in parallel with the

conveyor. The bins are arranged in descending heights starting from the edge of the conveyor. The cover of each bin maintains a sloped configuration when closed whereby gravity causes the long product to roll or slide down the closed lever cover. The lever cover of the correct bin is switched to an open position and those of the wrong bins to a closed position before the product is pushed off the conveyor, such that the product would roll over the closed bins until it drops into the open bin.

Figure 5A to C shows the preferred embodiment of a bins section in accordance with the present invention. In this example, a sliding plate 64 serves as a platform from where a product "kicked" from the conveyor would roll past. It allows the products to roll down from the conveyor effectively. A plurality of elongated support pillars 66 are provided adjacent to the support beam. The support pillars are aligned to support a structure of levers 68. The bins 70 are spaces provided between the support pillars. These bins have descending heights starting from the sliding plate. The levers can be switched to an open position, where upon products may be dropped into the bin below. Referring to Figure 6, lever 72 is in the open position, resulting in the product being dropped into bin 74, when the product is "kicked" off to the left of the conveyor by appropriate kickers. The levers are operated with pneumatic cylinders 76 and actuators by conventional mechanical means.

Figures 7A and B shows a computer method for the automation of the equipment and method described above. The switches for the control of the various equipment are connected to a control and display station. When the power of the control unit is switched on 105, the system to go through a self-check process 107. The first step of the operation is the input from the operator as to whether there is any remaining bundle in the current batch or a new batch is to be started 113. If there is no unsorted bundle in the current batch, i.e. the current batch has been completely sorted, a Change New

Batch Routine **115** is performed to allow the entry of all the necessary batch and product information required by the system. If there are still bundles remaining in the current batch, the operator is prompted for whether current infeed unsorted bundle is completed **117**. If there are still products in the current bundle, the operation proceeds to step **121**. However, if the current infeed unsorted bundle is completed, the Change Bundle Routine **119** is performed. All necessary bundle information are input to the system. When all information has been entered, the operation proceeds to step **121**. The conveyor system will be switched on at step **121**. All kickers, stoppers and pushers will be retracted to the home position **123**. All bin covers are also activated to the closed position. The system control **125** checks to ensure all pushers are down before switching on the "PUT IN" light **127** to signal to the operator that the system is ready for him to throw in a new product. In the next step **129**, the system checks the signal feedback by measurements made by the measuring sensors to determine the presence or absence of a product, and to check **131** if the product length is a valid length **133**. If the length is valid, implying that there is a suitable product in the measuring unit, the "PUT IN" light is turned off **139**, signaling to the operator not to throw any new product into the measuring unit. However, if the system detects an invalid length, a warning is issued **135**, and the control loops back **103** to step **121**.

As the operation proceeds, the length of the product is calculated **141**. Depending on the detected length, the correct section, sorting bin and stopper to be activated are identified in step **143**. The number of product in the identified bin and the current sorted bundle are determined in step **145**. If the current sorted bundle in this bin is full **147**, a New Sorted Bundle Subroutine is performed. This subroutine temporarily stops the system such that the operator can physically bundle up the complete bundle. If the current bin is full **151**, a Clear Bin Subroutine is performed. This subroutine stops the

machine and allows clearing of any bundle in all bins. If both current sorted bundle and bin are not full, Section 1 stopper will be raised in step 155 to confine the product to section 1. The system confirms in step 157 that the stopper is up before raising the pushers in step 159, which causes the
5 product to be pushed into the conveyor.

After some time delay 161, all pushers are retracted in step 163. Depending on the section the product is supposed to go, the sequence deviates after step 165. If the correct section is section 2 or section 3, section 1 stopper will be retracted in step 171 to allow for the product to pass
10 through. The correct stopper within section 2 or 3 will also be raised 173 to stop and position the product which would be traveling down the secondary conveyor after being released by the lowered section 1 stopper. Step 175 sends a signal to the correct bin cover for the lever to open. All kickers are then raised in step 177 to push the product out of the conveyor where it rolls
15 or slides down into the designated bin. After some time delay 187 to allow the product time to drop into the bin, the bin cover is closed 189. At the same time, the system ensure that the kickers are fully raised and subsequently fully retracted using steps 177-185.

At this point, the product is sorted, and the system updates the
20 production data 191. If the current infeed unsorted bundle is completed and a new bundle is to be sorted 193, the system will update 195 the production data by decreasing the number of unsorted bundle by one and the program loops 101 to step 113. If the current infeed unsorted bundle is not complete, the operation loops back 103 to step 121 and prompts the operator to throw
25 in a new product.

Although each support pillar have been described in the above examples as being designated for product for one length, it is possible that

each channel may be subdivided to store products of different lengths. This is accomplished by using stopper plates at different positions to confine a product to a particular segment or frame within a bin.

While the present invention has been described particularly with
5 references to Figures 1 to 7, with emphasis on a system for sorting long
products automatically, it should be understood that the figures are for
illustration only and should not be taken as limitation on the invention. In a
addition, it is clear that the method and apparatus for the present invention
has utility in many applications where automatic long product sorting is
10 required. It is contemplated that many changes and modifications may be
made by one of ordinary skill in the art without departing from the spirit and
scope of the invention as described.



CLAIMS

- 1 1. A long product sorting system comprising:
- 2 at least one measuring unit having measuring means for
- 3 ascertaining the length of each said long product and transferring means for
- 4 transferring onwards the measured long product; and
- 5 at least one receiving section proximate said measuring unit
- 6 and adapted for receiving measured long products transferred by said
- 7 transferring means therefrom, said receiving section having a plurality of
- 8 receiving means for receiving thereacross measured long products of similar
- 9 length, each said receiving means provided with covering means having an
- 10 open and a close position, said covering means in their close position
- 11 adapted to form a sloped top surface across said receiving section such that
- 12 said measured long products received from said measuring unit can gravitate
- 13 laterally from the top of one receiving means to the top of the next receiving
- 14 means along said sloped surface, said covering means further adapted to
- 15 move to an open position to allow a designated receiving means to receive
- 16 measured long products,
- 17 whereby said long products are sorted into designated receiving
- 18 means to the nearest standard length automatically.
- 19 2. The long product sorting system in claim 1 wherein a conveyor is provided
- 20 between said measuring unit and said receiving section, said conveyor
- 21 adapted to receive long products from said measuring unit and to transfer
- 22 long products to said receiving section therealong.



- 1 3. The long product sorting system in claim 2 wherein the conveyor is
2 aligned longitudinally between said measuring unit and the top edge of
3 said sloped surface of said receiving area, said conveyor comprising
4 stopping means disposed along the length of said conveyor for
5 stopping the forward movement of said measured long product along the
6 conveyor; and
7 unloading means disposed along the length of said conveyor for
8 unloading the measured long product laterally from said conveyor onto
9 said receiving section.
- 1 4. The long product sorting system in claim 2 further comprising at least one
2 secondary conveyor proximate at least one secondary receiving section,
3 said secondary conveyor adapted to transferring said long product from
4 said conveyor to at least one secondary receiving section, each
5 secondary receiving section having a plurality of secondary receiving
6 means with covering means, said covering means of said plurality of
7 secondary receiving means joining to form a sloped top surface of said
8 secondary receiving section.
- 1 5. The long product sorting system in claim 4 wherein the secondary
2 conveyor is aligned longitudinally with the top edge of said sloped surface
3 of said secondary receiving section, said secondary conveyor further
4 aligned axially with said conveyor, said secondary conveyor further
5 comprising
6 stopping means disposed along the length of said secondary conveyor
7 for stopping the forward movement of said measured long product
8 therealong,



9 unloading means disposed along the length of said secondary
10 conveyor for unloading the measured long product laterally from said
11 conveyor onto said receiving section.

12 whereby long products may be transferred from said measuring unit to
13 said secondary receiving section via the conveyor and the secondary
14 conveyor.

1 6. The long product sorting system according to any one of the preceding
2 claims wherein said plurality of receiving means are elongated in shape
3 with the longitudinal sides aligned in parallel, said aligned receiving
4 means further having descending heights with one longitudinal side of the
5 tallest receiving means disposed adjacent to said measuring unit whereby
6 a measured long product being transferred out of said measuring unit by
7 said transferring means will gravitate laterally along said receiving
8 section.

1 7. The long product sorting system according to any one of the preceding
2 claims wherein the covering means is a lever assembly.

1 8. The long product sorting system according to any one of the preceding
2 claims wherein said measuring means is at least one array of measuring
3 sensors.

1 9. The long product sorting system according to any one of the preceding
2 claims wherein said transferring means is an array of pushers.

1 10. The long product sorting system in claim 8 wherein said measuring
2 sensor are spaced at a predetermined distance from each other, said
3 predetermined distance corresponding to the tolerance of said long
4 product sorting system.



1 11. The long product sorting system in claim 8 or 10 wherein said measuring
2 sensor comprises an inductance proximity sensor.

1 12. The long product sorting system in claim 9 wherein said pusher comprises
2 a trapezoidal plate actuated with at least one pneumatic cylinder for
3 transferring said measured long products laterally to said receiving
4 section.

1 13. The long product sorting system in claim 7 wherein said lever assembly
2 comprises a lever hinged on supporting means, said lever further
3 actuated by a pneumatic cylinder.

1 14. The long product sorting system in any one of the above claims wherein a
2 measuring table is provided along one side of said measuring unit, said
3 measuring table adapted for urging said long products to gravitate
4 towards the side of said measuring unit.

1 15. The long product sorting system in any one of the above claims wherein a
2 controller is provided, said controller having at least one input means
3 adapted to receive measurement information, and at least one output
4 means adapted to transmit information.

5 16. A method of sorting long products using a long product sorting system,
6 said system including a measuring unit having sensing means and
7 transferring means, and at least one receiving section having a plurality of
8 receiving means with covering means, said method comprising the steps
9 of :

10 measuring the length of said long product using said measuring
11 means;

12 designating a receiving means for receiving said long product;



13 opening the covering means of said designated receiving means;

14 transferring said long product to a designated receiving means by
15 transferring means such that said long product is transferred laterally from
16 said measuring unit to said receiving section and travels laterally therealong
17 into the designated receiving means,

18 whereby said long products are sorted to the nearest standard lengths
19 automatically.

1 17.A method of sorting long products using a long product sorting system,
2 said system including a measuring unit, a conveyor and at least one
3 receiving section, said conveyor having stopping means and unloading
4 means, said receiving section further having a plurality of receiving means
5 with covering means, said method comprising the steps of :

6 moving a long product to said measuring unit, said measuring unit
7 having sensing means and transferring means;

8 measuring said length of said long product using said measuring
9 means;

10 designating a stopping means for stopping said long product along
11 said conveyor;

12 designating a receiving means for receiving said measured long
13 product;

14 opening the covering means of said designated receiving means;

15 raising said designated stopping means in said conveyor to stop said
16 long product at a designated position;



17 transferring said long product to said conveyor using said transferring
18 means;

19 stopping said long product at the designated position along said
20 conveyor by said stopping means; and

21 transferring said long product to a designated receiving means by
22 raising said unloading means such that said long product is unloaded
23 laterally from said conveyor to said receiving section and travels laterally
24 therealong into the designated receiving means,

25 whereby said long products are sorted to the nearest standard lengths
26 automatically.