**International Abstract:**

**Title:** CONTROLLING CURTAIN OPENING SYSTEM IN CONTINUOUS FURNACES

**Abstract:** This invention is directed to a controlling curtain opening system in a continuous furnace which comprises a laser photo cell eye system situated in front of the curtain box. The laser photo cell eye system comprises a plurality of laser beams to monitor and adjust to the height of a moving products passing through.
CONTROLLING CURTAIN OPENING SYSTEM IN CONTINUOUS FURNACES

CROSS-REFERENCE TO RELATED APPLICATION


FIELD OF THE INVENTION

[002] The present invention relates to a system in a heating furnace, and more particularly, controlling curtain opening system in a continuous furnaces.

BACKGROUND OF THE INVENTION

[003] Metal wire mesh, chain curtains and curtains made of Refrasil (tape and cordage) or other refractory materials are used in continuous furnaces. Box curtains containing a metal wire mesh (or metal chain) and several Refrasil, or Nextel 312 tape or cordage curtains located on the cold side of the metal mesh curtain are increasingly used in continuous furnaces. Also, various designs of box curtains are easier to visit, adjust, maintain and replace than the conventional curtains that are separately installed in continuous furnaces. A curtain box installed at the charge end, discharge end and between hot zone and cooling zone or between different zones, containing several curtains is easy to visit, maintain, adjust and replace, by opening a very well sealed cup on the top of the box. Such an assembly (curtain box or a box with curtains) will separate the temperature zones and atmosphere composition in a continuous furnace much better than the conventional curtains and will be easier to visit, maintain, adjust and replace.
[004] If curtain boxes or curtains are installed at the charge end opening and discharge end opening, they significantly contribute to reduce air ingress into the furnace, reduce protective atmosphere flow rate and reduce heat losses through the charge and discharge end openings. In continuous furnaces used in annealing of steel products, the curtain boxes or curtains installed at the discharge end of the continuous furnace do not have metal curtains and the materials could be less expensive because the working temperature is lower, such as to a temperature of less than about 650 °F.

[005] If curtain boxes or curtains are installed at the beginning of the cooling zone (or in the intermediary zone or at the end of the hot zone), they significantly contribute to reduce heat losses from the hot zone into the cooling zone, separate the atmosphere of the hot zone from that in the cooling zone (which require a higher H₂/H₂O ratio at lower temperature to protect against oxidation of metals) and permits a higher cooling rate, shortening the cooling time and, in many cases, the cycle time. In the case of austenitic stainless steels and other materials, cooling from the annealing temperature must be rapid, no more than approximately 3 minutes in cooling from about 1600 °F to about 800 °F. If cooling (zone) does not provide a cooling rate sufficient to prevent carbide precipitation, maximum corrosion resistance will not be obtained.

[006] It is therefore desirable in the art for an automatic curtain opening system that reduces incidents of product entangling and reduces fuel consumption.

**SUMMARY OF THE INVENTION**

[007] This invention is directed to a controlling curtain opening system in a continuous furnace which comprises a light-photo cell eye system positioned in front of a curtain box, a series of light beams casting across the light-photo
cell eye system there through, which measures the dimension of a metal substance passing across the series of light beams.

[008] This invention is also directed to a method of controlling the curtain in a continuous furnace, the method comprises a) positioning a light-photo cell eye system in front of a curtain box, in which a series of light beams casts across the light-photo cell eye system there through, b) measuring the dimension of a metal substance passing across the series of light beams, and c) adjusting the opening of the curtain using the measurements from the dimension of the metal substance.

**BRIEF DESCRIPTION OF THE DRAWINGS**

[009] While the specification concludes with claims distinctly pointing the subject matter that applicants regard as their invention, it is believed that the invention would be better understood when taken in connection with the accompanying drawings in which FIG. 1 is a perspective view of the metal assembly in a controlled atmosphere as embodied in this invention, and FIG. 2 is a perspective view of the moving products relative to the laser photo cell eye system.

**DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS**

[0010] Selection of curtain material and adjustment of curtain(s) should take into account the danger of Refrasil or Nextel 312 curtain and the product scratching of metal curtains (chains and wire mesh). The curtains should have an opening that avoids entangling and scratching of moving products.

[0011] Product, such as steel tubes, steel bars, etc., entangling with curtains made of Refrasil or Nextel 312, product scratching with curtains made of
metal wire mesh or metal chain could be removed by manual or automatic adjustment of curtains opening, depending on the height of the product.

[0012] An automatic adjustment of curtains opening system could be installed in continuous furnaces, including belt, humpback, roller hearth, and pusher continuous furnaces using a plurality of gases including N₂ and H₂, Ar and He, or substantially pure H₂ to anneal different products. The products include steel and stainless steel tubes, bars, stainless steel sinks, etc.

[0013] The automatic curtain opening adjustment system of this invention depending on the height of the products, in continuous furnaces, is showed in FIG. 1. The system automatically adjusts the opening of curtains in the curtain boxes installed at the charge vestibule, discharge vestibule and at the beginning of the cooling zone (or in the intermediary zone or at the end of the hot zone). A source of light or a laser on one side of the charging (loading) table (the light-photo cell eye system) and photo-electric cells on the other side of the charging table (the light-photo cell eye system) would sense the height of the moving product or group of products (in FIG. 2 shown as steel bars or steel tubes). The signal is captured by a processor which will increase or decrease curtains opening through an electro-mechanical system (electrical servo-motor and gears system or screw system). Opening of curtains in a curtain box could be adjusted automatically by a program in addition to a laser (or light)-photo cell eye system, depending on the height of the product.

[0014] FIG. 1 shows the continuous furnace with automatic adjustment of curtains opening depending on the height of the moving products. The moving products is a metal substance. The system 100, is provided where a metal substances is passed through a changing table 110 on which a laser-photo cell eye system 115 is placed. The metal then passes through a first curtain box 120, a charge vestibule 125, followed by hot zone 130, a second
curtain box 135 and a cooling zone 140. After the cooling zone, the metal passes through a discharge vestibule 145 followed by a third curtain box 150.

[0015] FIG 2 shows a laser photo cell eye system measuring the height of the product and automatically adjusting the opening of the curtains in the curtain box. The beam of light 210 measures the height of the product 220 and automatically adjusts the opening of the curtains in the curtain box.

[0016] In an embodiment, the curtain opening system of this invention eliminates or significantly reduce incidents of product (steel tubes, steel bars, etc.) entangling with curtains made of Refrasil or Nextel 312 and product scratching with curtains made of metal wire mesh or metal chain.

[0017] In an embodiment, the curtain opening system of this invention reduces consumption of fuel (ex. natural gas) used for heating the furnace by 10%-22%.

[0018] In an embodiment, the curtain opening system of this invention reduces the consumption of the gas(es) used for the atmosphere by 10%-20%. This aspect contributes to reducing the cooling time.

[0019] In an embodiment, the curtain opening system of this invention is easy to build, install and could work for groups of moving products of different heights. Each group of moving products must have the same height.

[0020] In an embodiment, the curtain opening system of this invention actuates a curtain box, which is installed at the beginning of the cooling zone (or in the intermediary zone or at the end of the hot zone), could contribute to a higher rate of cooling by significantly reducing heat losses from hot zone into the cooling zone. In an embodiment, the products made of austenitic stainless steels and other materials, proceeds with cooling from the annealing.
temperature that must be rapid, and no more than approximately 3 minutes in
cooling from about 1600 °F to about 800 °F).

[0021] In an embodiment, the curtain opening system of this invention
provides for laser (or light)-photo cell eye system could verify the settings of
the program for a given product, to ensure the correct setting of the curtain
opening.

[0022] It will be understood that the embodiment(s) described herein are
merely exemplary, and that one skilled in the art may make variations and
modifications without departing from the spirit and scope of the invention. All
such variations and modifications are intended to be included within the
scope of the invention as described hereinabove. Further, all embodiments
disclosed are not necessarily in the alternative, as various embodiments of
the invention may be combined to provide the desired result.
What is claimed is

1. A controlling curtain opening system in a continuous furnace which comprises a light-photo cell eye system positioned in front of a curtain box, a series of light bedims casting across the light-photo cell eye system there through, which measures the dimension of a metal object passing across the series of light beams.

2. The controlling curtain opening system of claim 1 wherein the light-photo cell eye system comprises a source of light on one and a photoelectric cell on the other side there through.

3. The controlling curtain opening system of claim 1 wherein the light-photo cell eye system comprises a plurality of light beams to monitor and adjust to the height of a moving products passing there through.

4. The controlling curtain opening system of claim 3 wherein a signal processor processes signals from the light beams that passes the metal objects.

5. The controlling curtain opening system of claim 3 wherein the light-photo cell eye system adjusts the opening of curtains in the curtain box by a electro-mechanical system.

6. The controlling curtain opening system of claim 5 wherein the electro-mechanical system comprises an electrical servo-motor and gear system or screw system.

7. The controlling curtain opening system of claim 1 wherein the light beams are laser beams.
8. A method of controlling the curtain in a continuous furnace, the method comprises
   a) positioning a light-photo cell eye system in front of a curtain box, in which a series of light beams casts across the light-photo cell eye system there through,
   b) measuring the dimension of a metal substance passing across the series of light beams, and
   c) adjusting the opening of the curtain using the measurements from the dimension of the metal substance.

9. The method of claim 8 which comprises passing a light source from one side of the light-photo cell eye system to photo-electric cell on the other side of the light-photo cell eye system.

10. The method of claim 8 which comprises passing a plurality of light beams to monitor and adjust to the height of a moving products passing there through.

11. The method of claim 8 which further comprises passing signals resulting from the passing a plurality of light beams to monitor and adjust to the height of a moving products passing the light-photo cell eye system to a signal processor.

12. The method of claim 8 which further comprises adjusting the opening of curtains in the curtain box by an electro-mechanical system triggered from the signal processor.

13. The method of claim 12 wherein the electro-mechanical system comprises an electrical servo-motor and gear system or screw system.

14. The method of claim 8 wherein the light beams are laser beams.