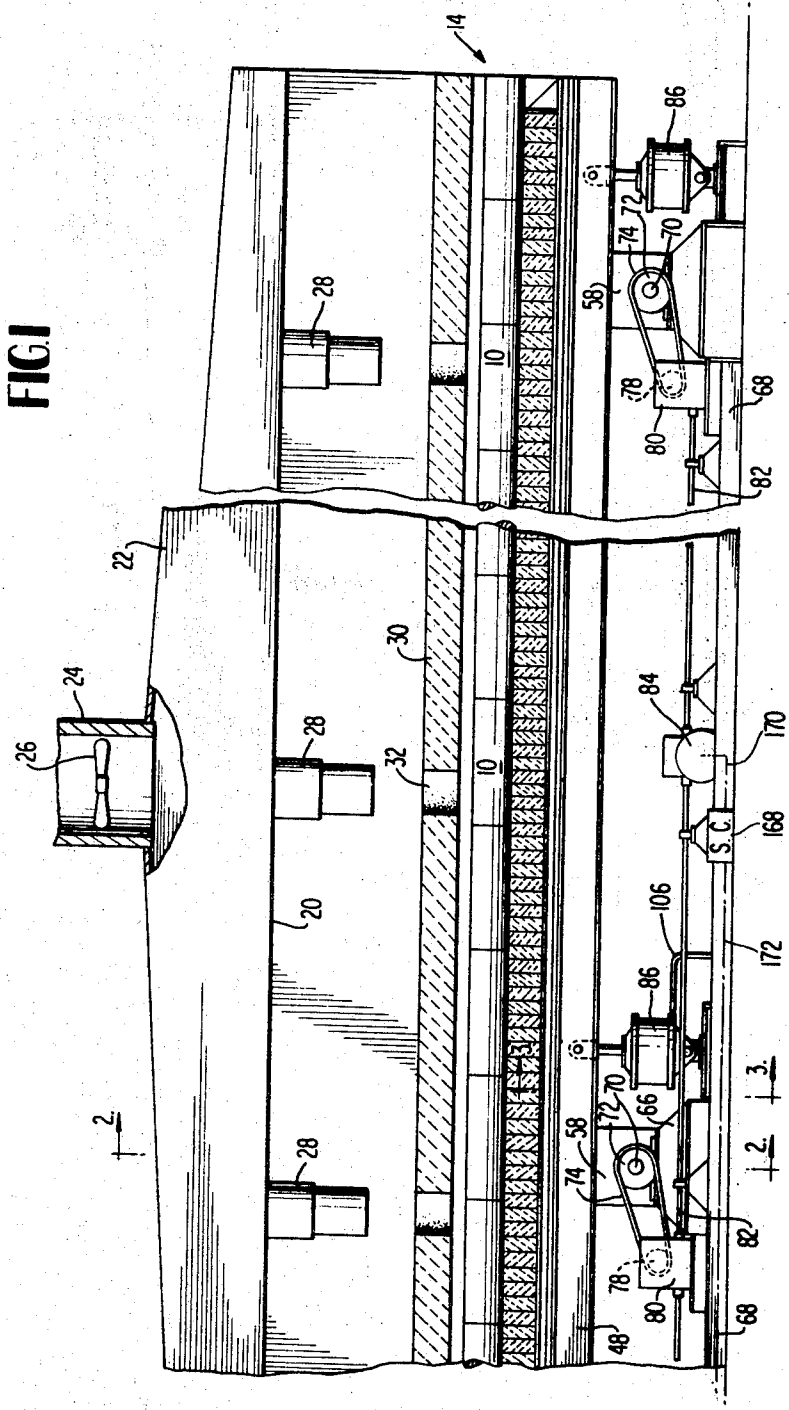
March 2, 1971 C. B. GENTRY 3,567,198

RETRIEVER MEANS FOR WALKING BEAM FURNACE

Filed Nov. 14. 1969 5 Sheets-Sheet 1

FIG. 1



INVENTOR
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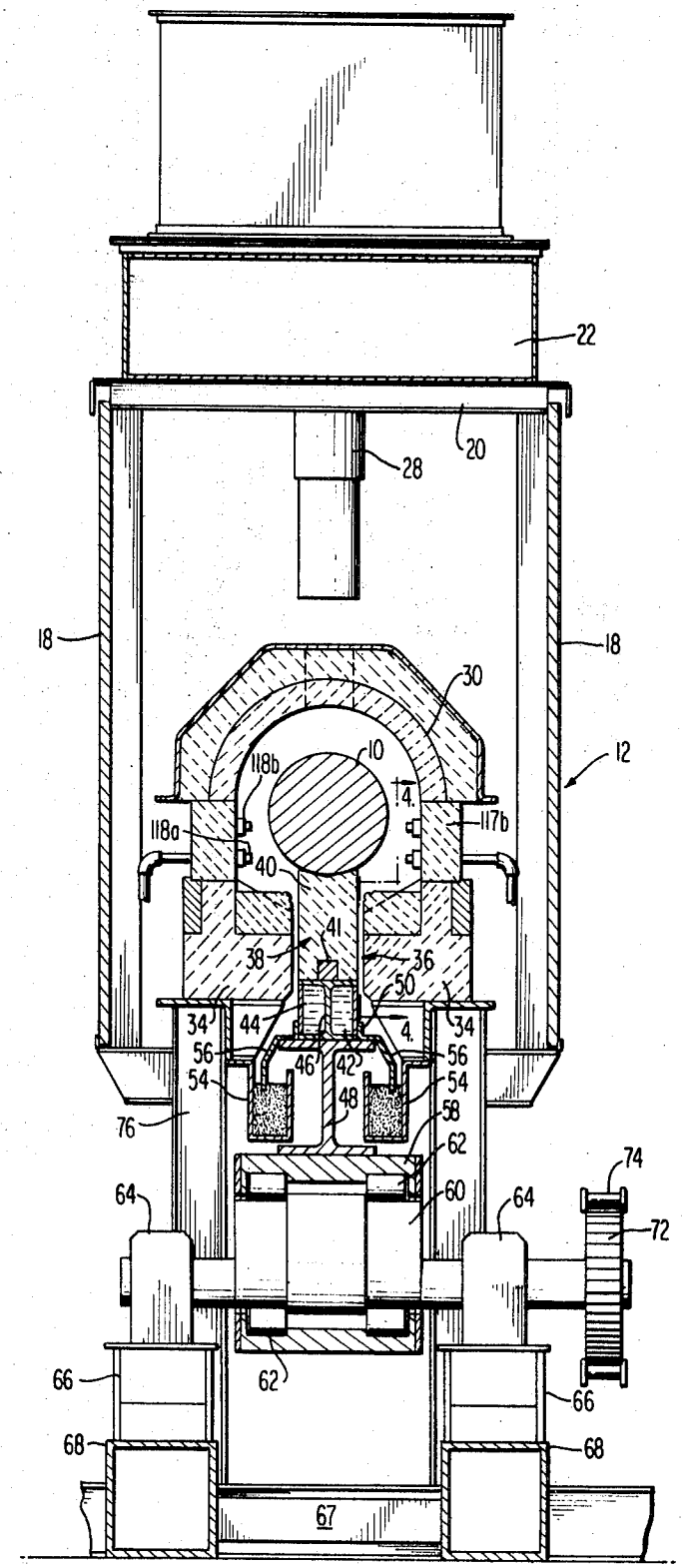
BY Price, Heneveld, Huizenga & Cooper

ATTORNEYS

RETRIEVER MEANS FOR WALKING BEAM FURNACE

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FIG2



RETRIEVER MEANS FOR WALKING BEAM FURNACE

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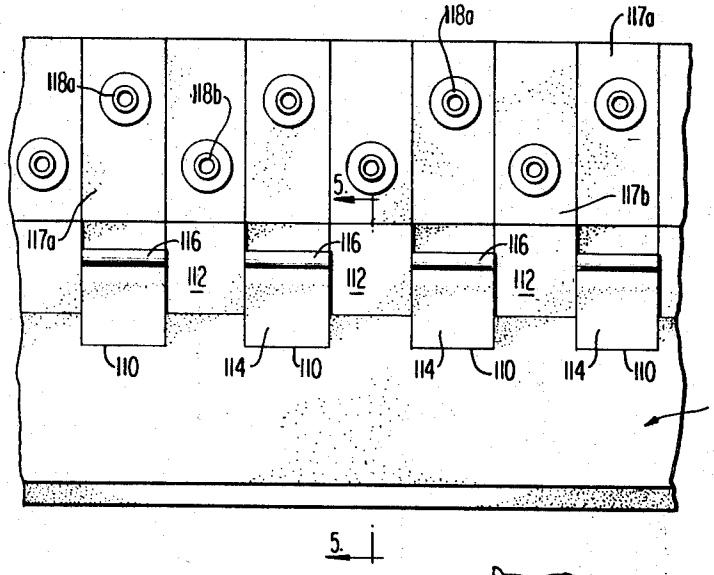


FIG.4

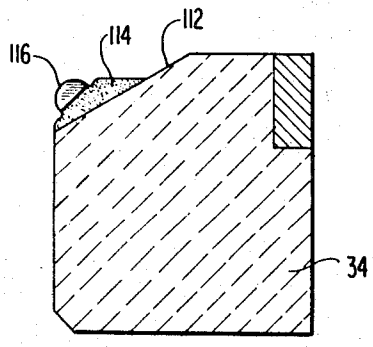


FIG.5

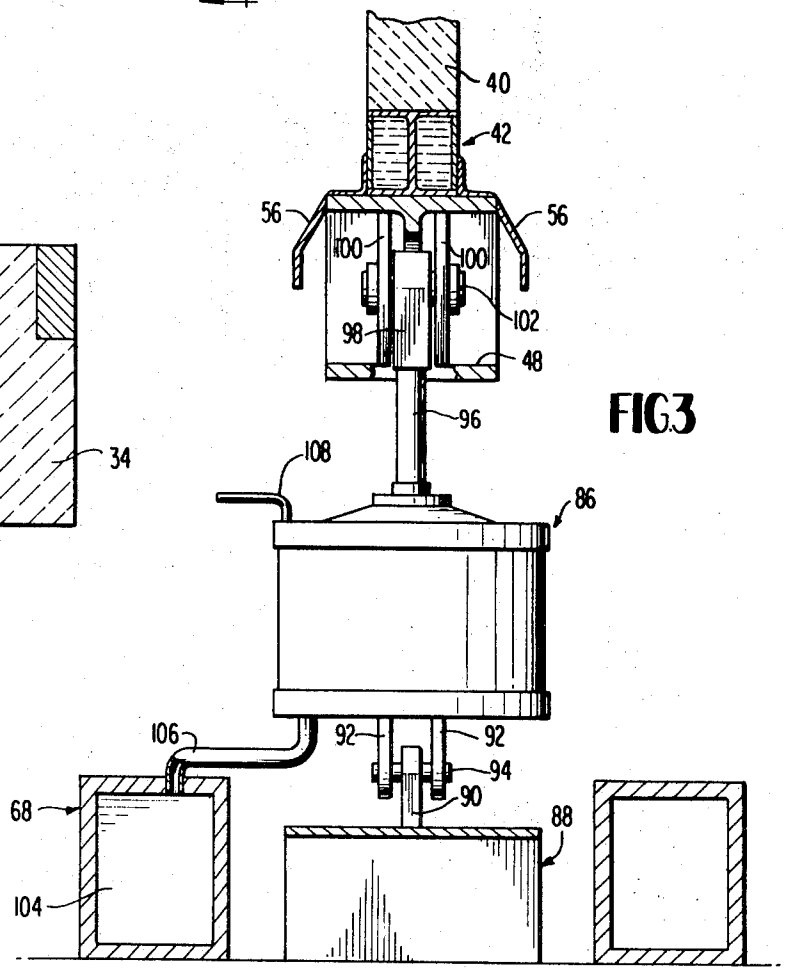


FIG.3

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RETRIEVER MEANS FOR WALKING BEAM FURNACE

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FIG. 6

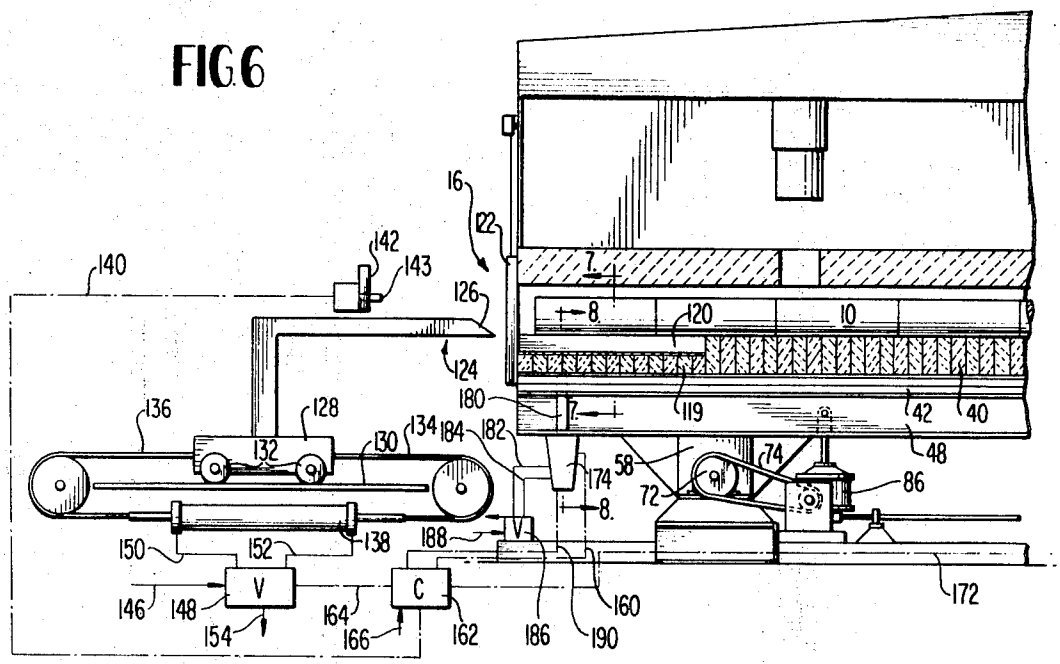


FIG. 7

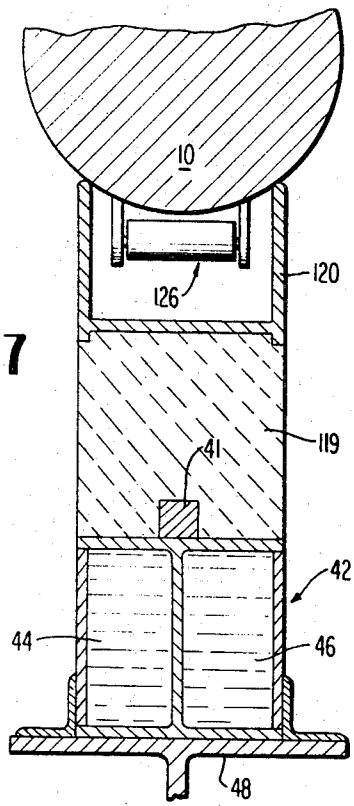
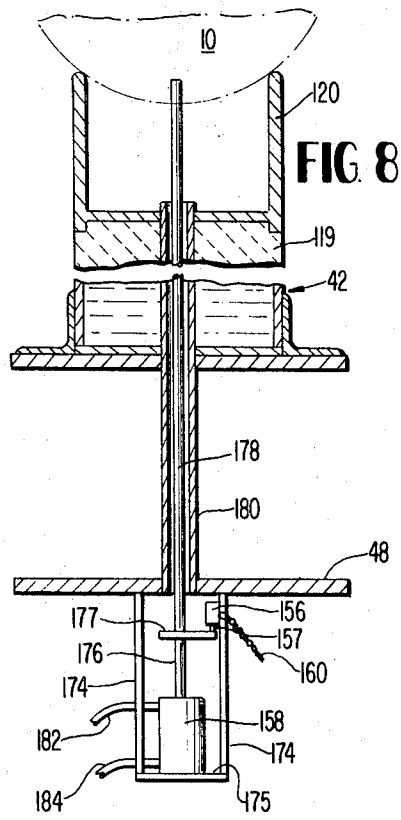


FIG. 8



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RETRIEVER MEANS FOR WALKING BEAM FURNACE

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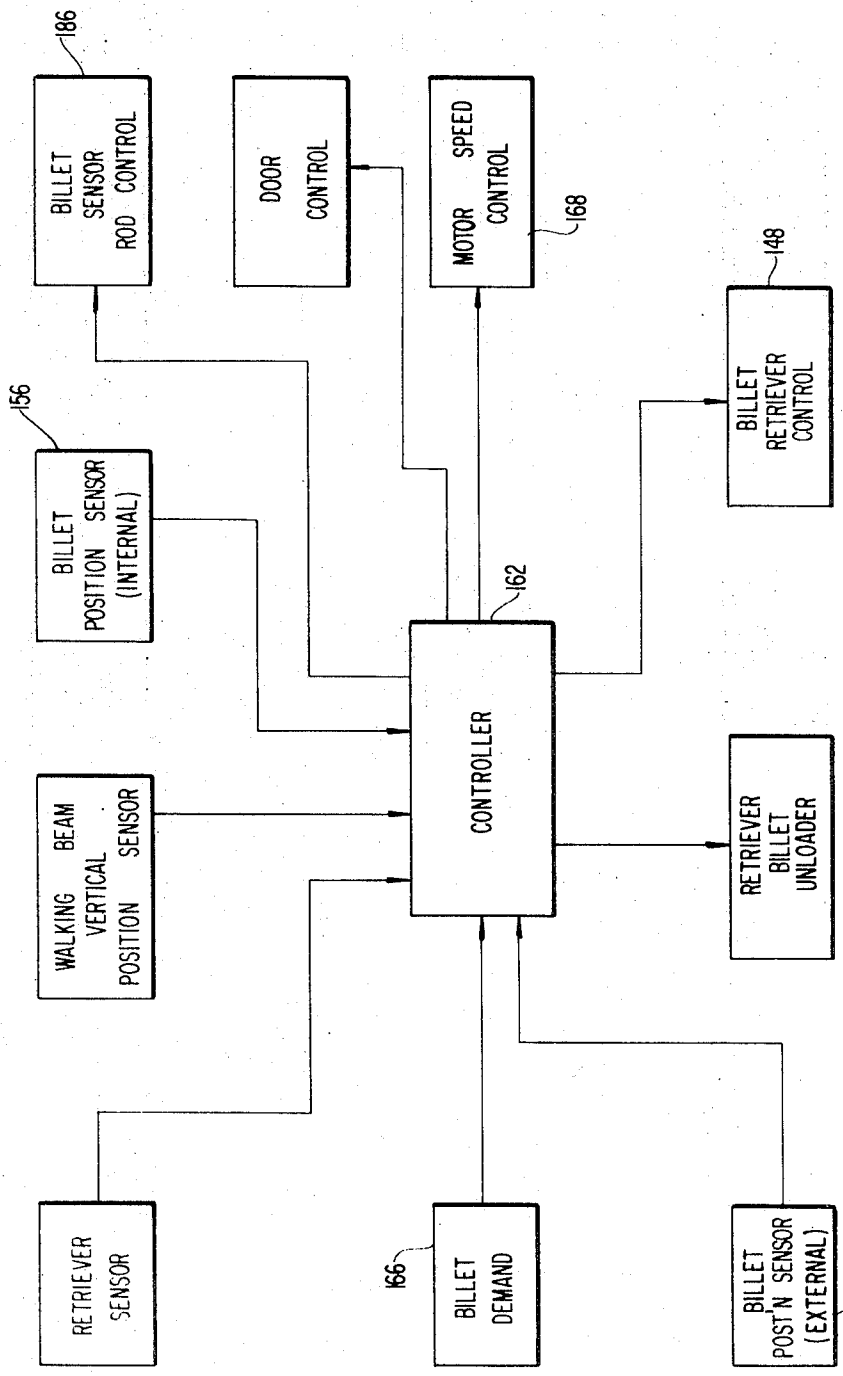


FIG 9

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United States Patent Office 3,567,198
Patented Mar. 2, 1971

3,567,198

RETRIEVER MEANS FOR WALKING BEAM FURNACE

Charles B. Gentry, Grand Rapids, Mich., assignor to Granco Equipment, Inc., Grand Rapids, Mich.

Filed Nov. 14, 1969, Ser. No. 876,860
Int. Cl. B65g 25/04; F27b 9/14
U.S. Cl. 263—6 17 Claims

ABSTRACT OF THE DISCLOSURE

This disclosure relates to a walking beam furnace for heating billets and a retriever for the heated billets. The walking beam has a power means with a speed reducing drive and a lower speed is employed while removing the heated billets from the end of the furnace. The retriever device has a forward wedging surface which forces the billets upwardly as the retriever device is moved into the furnace. The billet falls onto the retriever and the billet and retriever are then withdrawn from the furnace.

This invention relates to billet heating furnaces. In one of its aspects, the invention relates to a billet heating furnace in which billets are conveyed through a furnace on a walking beam and a retriever means having a forward wedging means advances into the furnace and wedges the billet upwardly onto the retriever means, wherein means are provided to reduce the speed of the walking beam as the retriever means enters the furnace to permit the retriever to pick up the billet while the walking beam is at a predetermined position.

In U.S. Pat. No. 3,415,393, there is disclosed and claimed a billet retrieving device in which a retriever member having a forward wedging means is advanced into a furnace to lift one end of a billet off its supporting rails. As the retriever member continues to advance, the billet becomes unstable and then falls onto the retriever. The disclosed furnace is one in which billets are pushed through the furnace on stationary supports.

I have now discovered that this retriever device can be adapted for removal of billets from a moving walking beam furnace by slowing down the walking beam movement and synchronizing the movement of the billet retriever to a particular position on the walking beam.

By various aspects of this invention one or more of the following, or other, objects can be obtained.

It is an object of this invention to provide a device to remove heated billets from the end of a walking beam furnace.

It is another object of this invention to provide a system and method for transporting billets through a furnace and for removing the billets as needed from the exit end of the furnace.

Other aspects, objects, and the several advantages of this invention are apparent to one skilled in the art from a study of this disclosure, the drawings, and the appended claims.

According to the invention there is provided a walking beam furnace having a longitudinal furnace chamber with an entrance end and an exit end. A walking beam extends through the furnace chamber for moving billets therethrough as they are heated within the furnace. Means are provided to drive the walking beam through an orbital path to move the billets from the entrance end to the exit end. Means for retrieving the heated billets from the exit end of the furnace comprise a billet support member having a forward wedging means and means for moving the billet support member into the end of the furnace. The drive means for the walking beam has a speed reducer which is operable to slow down the movement of the

walking beam as the retriever means advances into the furnace. Preferably the retriever means is synchronized with the walking beam so that the retriever member enters the furnace when the walking beam is at a predetermined position.

The invention will now be described with reference to the accompanying drawings in which:

FIG. 1 is a partial side elevational view in section illustrating a furnace according to the invention;

FIG. 2 is a front elevational view in section taken along lines 2—2 of FIG. 1;

FIG. 3 is a partial front elevational view in section taken along lines 3—3 of FIG. 1;

FIG. 4 is a partial sectional view seen along lines 4—4 of FIG. 2;

FIG. 5 is a partial sectional view along lines 5—5 of FIG. 4;

FIG. 6 is a side elevational view in section of an end portion of the furnace, schematically illustrating a retriever device;

FIG. 7 is a partial sectional view taken along line 7—7 of FIG. 6 showing the relationship between the retriever device and the end of the furnace;

FIG. 8 is a sectional view taken along lines 8—8 of FIG. 6, showing the billet sensing mechanism with the end billet removed; and

FIG. 9 is a block diagram of a control system used in the invention.

Referring now to the drawings, and to FIGS. 1 through 3 in particular, there is illustrated a furnace **12** for heating a plurality of cylindrical billets **10**. The furnace has an entrance end **14** and an exit end **16** (FIG. 6). Side wall panels **18** and a top wall panel **20** encase the furnace. An exhaust manifold **22** and an exhaust conduit **24** have a fan **26** which draws exhaust gases through adjustable exhaust pipes **28** from the furnace.

The furnace is formed from a top refractory member **30** having vertical exhaust holes **32** which communicate with the exhaust pipes **28** for removing gases from the furnace. Bottom refractory members **34** form the bottom portion of the furnace and are spaced from each other to provide a longitudinal opening **36**. A walking beam **38** is positioned for circular or orbital movement within the longitudinal opening **36**. The walking beam **38** is formed from a plurality of refractory blocks **40** having a wide V-shaped upper surface, a cooled support member **42** and a support I beam **48**. The cooled support **42** has water passages **44** and **46** through which water is circulated to provide a cooled barrier between the support I beam **48** and the refractory block **40**. The refractory blocks **40** have a recess **41** at the bottom. A spline bar **52** fits within the recess **41** and positions the refractory block **40** on the support **42**. Means (not shown) are provided at either end of the walking beam to compress the refractory blocks **40** to hold them in place. Angle irons **50** secure the cooling block **40** on the I beam **48**.

A bottom heat seal for the furnace is formed by troughs **54**, which are secured to the bottom of the furnace, and by sealing flanges **56**, which depend from the top of the I beam **48** and extend into the trough **54**. Water or sand or other suitable sealing material can be provided in the troughs to prevent air from entering the furnace through the longitudinal opening **36**.

The walking beam is supported by an eccentric drive comprising an annular support member **58** which journals an eccentric hub **60** through bearings **62**. The eccentric hub **60** is supported at the sides by side holder **64**, upright supports **66** and horizontal beams **68**. Each beam **68** has a hollow central core which can serve as a gas conduit. The outboard end **70** of the eccentric hub **60** has a sprocket wheel **72** fixed thereto. A chain **74** engages the

sprocket **72** and a sprocket wheel **78** to drive the eccentric hubs **60**. The sprocket wheel **78** is driven through a motor **84**, a drive shaft **82** and gear box **80**. A speed controller **168** is provided to control the speed of motor **84**.

The furnace refractory sections **34** are supported by the beams **68** and upright support beams **76**.

The walking beam is biased upwardly by a gas cylinder **86**. A box beam **88** having an upright flange **90** pivotally supports the gas cylinder **86** through depending ears **92** and pin **94**. The piston rod **96** from the gas cylinder **86** extends upwardly through an aperture in the support I beam **48** and pivotably engages the I beam **48** through collar **98**, plates **100** and pin **102**. A constant gas pressure is supplied to cylinder **86** through an air supply manifold **104** within each of the hollow beams **68** and conduit **106**. The hollow beams **68** have a manifold **67** (FIG. 2) between them to equalize the pressure therein. A vent **108** is provided at the upper portion of the gas cylinder to permit discharge of air from the cylinder as the piston (not shown) moves within the cylinder.

Referring now to FIGS. 4 and 5, the bottom refractory members **34** are formed from a plurality of sections approximately two feet long extending the length of the furnace. Each section contains a plurality of spaced openings **110** which are juxtaposed to sections having sloping inner corners **112**. Separate and removable pier blocks **114** fit into the openings **110** and extend out into the furnace above the sloping inner corners **112** for supporting the billets **10**. Each pier block **114** has a rounded corner and a support corner cap **116** thereon. The support corner cap **116** is made out of a high temperature alloy metal and the pier blocks **114** are made out of a refractory material. The billets **10** are supported by and contact the caps **116**.

The furnace is fired by a plurality of burner tiles forming an upper row **117***a* having nozzles **118***a* and a lower row **117***b* having nozzles **118***b*. The burners direct a flame into the center of the furnace to envelop the billets with a reducing portion of the flame. The upper row **117***a* is directly above the pier blocks and the lower row **117***b* is above the sloping corners **112**. The flames from the lower row **117***b* of burner tiles will extend down along the sloping corner **112** and envelop the bottom of the billets when the billets are heated on the pier blocks **114** and will pass beneath the billets when the billets are raised off the pier blocks. The flames from the upper row **117***a* will tend to pass over the tops of the billets regardless of whether the billets are resting on the pier blocks or are raised in the position shown.

As an alternate embodiment, the refractory blocks **40** can comprise juxtaposed sections of higher and lower refractory blocks to permit the flame to pass beneath portions of the billets when the billets are supported by the walking beam. The higher refractory blocks will support the billets and the flame will pass between the lower refractory blocks and the billets.

Reference is now made to FIGS. 6 and 7 which illustrate the means for removing the heated billets from the end of the furnace. Adjacent the exit end **16** of the furnace there are provided special refractory support blocks **119** which are shorter than the refractory support blocks **40**. A U-shaped channel **120** is supported by the blocks **119**, the channel **120** forming a support for the billets **10**. At this end of the furnace, the billets are fully heated and there is no need to provide high intensity burners. Thus the U-shaped channels can be made of high temperature alloy metal and will not be severely affected by the high heat used to heat the billets in the heating sections of the furnace.

The means for removing the heated billets from the furnace is illustrated schematically in FIG. 6. This billet retriever per se is more fully described and is claimed in United States Patent No. 3,415,393. This patent is incorporated herein by reference.

Briefly, the billet retriever enters the furnace when the door **120** is raised. The retriever device **124** has a forward wedging means **126** which is supported on a car **128**. A track **130** guides and supports the wheels **132** of the car **128**. Pulley ropes **136** are affixed to either end of the car **128** and are driven by a hydraulic cylinder **138**. Fluid under pressure is supplied to cylinder **138** through line **146**, four-way valve **148**, and lines **150** or **152**. In one position of the valve, fluid passes to the cylinder **138** from line **146** which fluid flows from the opposite end of the cylinder **138** through valve **148** and through exhaust line **154**. In another position of the valve, fluid flows from line **146** through valve **148** and line **152** to the right end of cylinder **138** while fluid is exhausted from the cylinder through line **150**, valve **148** and line **154**. A piston (not shown) within the cylinder is moved from one end of the cylinder to the other by the fluid, and thereby moving car **128** on track **130**. A fixed stop member **142** above the retriever device supports a limit switch **143**. A control line **160** extends between switch **143** and a controller **162**.

Suitable means for removing the billet from the retriever device **124** are disclosed in said patent 3,415,393. Other suitable means for removing the billet from the retriever device **124** are disclosed and claimed in copending U.S. patent application Serial No. 747,685, filed July 25, 1968. Desirably, the limit switch **143** is provided at the stop member **142** to actuate the removal means.

A switch **156** is mounted beneath the beam **48** on side plates **174** which are welded to the bottom of beam **48**. The details of the switch and air cylinder **158** are shown more clearly in FIG. 8. In FIG. 8, the end billet has been removed to illustrate the position of the plunger with respect to the bottom of the billet.

Referring to FIG. 8, the switch **156** contains an actuating button **157** and is welded to one side plate **174**. The air cylinder **158** is fixed to a bottom plate **175** and has a reciprocable plunger rod **176** which is fixed to a bar **177**. The bar **177** extends laterally to strike the actuating button **157** of switch **156** when the piston rod **176** is in the extended position shown. A plunger **178** is fixed to the bar **177** and extends through a tube **180** above the plane of the bottom of a billet. A hole is drilled through I beam **48**, cooled support **42**, refractory support block **119** and U-shaped channel **120** to accommodate the tube **180**. The tube **180** is suitably secured to the I beam **48**, cooled support **42** and U-shaped channel **120** by welding. The air cylinder **158** is connected to an air supply line **188** through four-way valve **186** and lines **182** and **184**.

The switch **156** communicates with a controller **162** by control line **160**. A control line **164** extends between the controller **162** and four-way valve **148**. Still another control line **190** extends between controller **162** and valve **188**. An input **166** actuates the controller **162** to move valve **148** so that fluid flows through line **152** to move the retriever into the furnace exit end. However, the controller **162** does not operate to switch valve **148** until the beam **48** is in a predetermined position as indicated by switch **156**. The controller **162** communicates with speed controller **168** (FIG. 1) through control line **172**. The controller **162** has an input switch **166** to actuate the removal of the billet from the end of the furnace.

In operation, a billet **10** is pushed into the furnace onto the walking beam **38** by any suitable loading means. The billet rests on the wide U-shaped upper surface of the refractory blocks **40**. All billets are generally in end to end contact on the walking beam refractory members **40** for maximum space utilization. The billets are moved through the furnace on the walking beam and are removed by the billet retriever illustrated in FIGS. 6 and 7.

As a billet is moved into the exit end of the furnace onto the channel **120**, a new billet can be pushed into the furnace. The billets are moved from the entrance end to the exit end of the furnace by the walking beam **38** until the end billet trips the switch **156**. The beam moves in an orbital motion in a vertical plane (as viewed in FIGS. 1 and 6) with the top of the refractory blocks **40** rising above the top of the pier blocks **114** as the beam moves

towards the exit end of the furnace. After the top of the refractory blocks **40** have fallen below the top of the pier blocks, the beam then moves back towards the front end of the furnace. In the drawings, the walking beam is shown in its uppermost position.

The billets are supported by the pier blocks **114** during that time in which the beam **38** moves back towards the front end of the furnace. The billets are supported by the refractory blocks **40** as the beam **38** moves towards the exit end of the furnace. In this manner, the billets are moved from the entrance end of the furnace to the exit end thereof in incremental steps. The movement of the walking beam stops when the end beam reaches the position shown in FIG. 6 until the end billet is withdrawn from the furnace. The walking beam is controlled so that the beam will stop at the bottom of its throw so that during this idle position, the billets will rest on the pier blocks.

The billets are heated in the heating section of the furnace as they move therethrough by direct impingement of the flame from the burners on the billets. Preferably, the billets are enveloped by a reducing portion of the flame to minimize oxidation on the outer surface of the billets. This is accomplished by placing the burner tiles in close proximity to the billets and by adjusting the velocity and mixture of the combustible fuel entering the burners. The products of combustion are exhausted from the furnace through the vertical exhaust holes **32**, exhaust pipes **28**, manifold **22** and exhaust conduit **24**.

Movement of the beam **38** is caused by eccentric hub **60** which rotates by sprocket wheel **72** and chain **74**. A plurality of such hub containing mechanisms are spaced along the length of the furnace. Each such mechanism is driven by motor **84** at a constant speed through drive shaft **82**, gear box and chain **74**. Thus, the hub **60** rotates at a constant speed, thereby moving the walking beam **38** at a constant rate.

While the walking beam **38** is walking the billet into the exit end of the furnace, the plunger **178** will be in the position illustrated in FIG. 8. In this position, the top of the plunger extends above the plane of the billet bottom so that the plunger can sense when the billet reaches the end of the furnace in position for retrieval. When the billet reaches the end of the furnace, it will strike the top of plunger **178** and push the same downwardly to trip switch **156**, the bar **177** breaking contact with button **157**. A signal is then sent from switch **156** via control line **160** to controller **162**. Responsive to this signal, the controller **162** will signal the speed controller **168** to change motor **84** to a lower speed until the walking beam reaches the bottom of its throw. At that point, all of the billets will be resting on pier blocks so that the flame can most efficiently envelop the billets. The walking beam will then be stopped and a billet will be ready for retrieval. The stopping of the walking beam can be switch actuated or by a time control. A switch (not shown) can be placed beneath the beam to indicate when the beam has reached the bottom of its throw. The controller **162** then signals valve **186** to change position so that the air pressure is passed through line **182** to the upper end of cylinder **158**, forcing piston rod **176** and plunger **178** downwardly. The piston rod moves down sufficiently to retract the plunger **178** to the bottom of channel **120**. This permits the retriever means to pass within the channel **120** without obstruction from the plunger.

According to one aspect of the invention, in order to facilitate the removal of the heated billets from the exit end of the furnace, the motor has a variable speed control so that it can be operated at a lower speed than normally used in moving the billets through the furnace. The slower speed is used when the billets are removed from the furnace with the retriever device to position the walking beam for removal of the billets.

When a heated billet is needed, the operator activates the removal mechanism by pushing input switch **166**. The controller then signals the speed controller **168** to start the motor on low speed until the walking beam reaches the top of its throw. The beam is then stopped at this top position by the controller, the exit door **122** opens and the retriever device enters the furnace to remove the end billet from the furnace. The forward wedging means **126** of the retriever device is advanced into the furnace until the end billet drops onto the retriever device. The wedging means pushes the forward end of the billet upwardly until it becomes so unstable that it drops onto the retriever device. The retriever device fits between the U-shaped channel as illustrated in FIG. 7. The billet and the retriever device are then withdrawn from the furnace until the billet strikes the limit switch and stop **142**. The switch **143** actuates the controller to switch valve **148** to a neutral position to stop the movement of the billet retriever **124**. The heated billets can then be removed from the billet retriever **124** and taken to an extrusion press for fabrication into metal parts. Alternately, a limit switch can be placed outside the furnace door to sense the position of the other end of the billet, and responsive thereto, the retriever device is stopped. After removal of the billet from the furnace, the door **122** is then closed.

The timing of the retriever device with respect to the movement and position of the walking beam is controlled by the controller **162**. The controller will signal valve **148** to change after the walking beam reaches the proper position with respect to the height of the retriever **124** and the walking beam has stopped its movement. A sensor at the beam, or a timing device, can be used to ascertain when the beam has reached its uppermost position. The controller **162** then signals valve **148** to permit fluid to flow from line **146** through line **152** to the right end of cylinder **138**. This flow of fluid causes the retriever to enter the end of the furnace as hereinbefore described.

After the end billet has fallen onto the retriever device **140**, the controller signals valve **148** to switch back to its original position whereby the fluid flows into the left end of the cylinder **138** from line **146** through line **150**. In this manner, the retriever device **124** is withdrawn from the end of the furnace. The controller then signals the valve **186** to change so that the air pressure flows into line **184** to raise plunger **178** to the position illustrated by FIG. 8. The controller **162** then signals speed controller **168** to increase the speed of motor **84** to normal until the end billet contacts the sensing mechanism.

According to a preferred embodiment of the invention, the retriever device **124** is set to remove the end billet from the furnace when the walking beam reaches its uppermost position of its cycle. At this point, the billet is fully supported by the walking beam. This position is deemed to be desirable although the retriever and controller could be set at other positions of the walking beam cycle.

In the movement of the walking beam described in the drawings, the greatest power for the system is required to raise the walking beam **38** above the pier blocks so as to lift the billets up and carry them forward toward the exit end of the furnace. For large copper or brass billets, for example, the weight of the walking beam and the billets can be as much as one thousand pounds per foot of walking beam. The length of the furnace can vary from thirty to one hundred feet and thus the total weight to be raised by the motor would be thirty thousand to one hundred thousand pounds. The motor must therefore be geared to the maximum amount of force required to raise the beam and the load of billets.

The movement of the walking beam is aided and cushioned by the application of air pressure through cylinders **86** and piston rod **96**. The cylinders are also disposed along the length of the furnace. Each cylinder is filled with a predetermined presure from manifold **104**. This air pressure is transmitted through the piston rod **96** to the beam **38**. The air pressure in the cylinder can be adjusted to minimize the power requirements or current draw of

the motor. This can be done manually or automatically through suitable instruments.

The air pressure assists the motor in raising the beam and in lifting the billets off the pier blocks. As the beam starts to move downwardly from its uppermost position, the air pressure continues to apply an upward force to the beam, thereby acting against the weight of the billets and the beam. In this manner, the reverse torque caused by the weight of the billets and the walking beam can be minimized. Further, the torque reversal on the motor due to the change from upward to downward motion of the walking beam is severely cushioned. The air pressure can be adjusted to substantially eliminate the torque reversal effect by adjusting the air pressure so that the force on the beam from the gas cylinders is equal to or greater than the weight of the beam. In such a case, the motor will be working against the air pressure in the downward cycle.

The effect of the air cylinder is to minimize the force required for operating the walking beam and to decrease the wear on the motor drive and its associated moving parts. Therefore, smaller motors can be used to operate the walking beam and these smaller motors will have longer life.

The gas cylinders **86** have an open connection to the manifold **104**. The pressure in the manifold remains substantially constant, and therefore the pressure in the gas cylinders remain substantially constant. The force from the gas cylinders is thus substantially constant but yieldable with the movement of the walking beam. The billets have a floating or cushioned ride on the walking beam with the use of the gas cylinders **86**.

This floating ride of the walking beam avoids banging of the support parts due to torque reversal and permits more accurate control of the beam. The billets can be raised and lowered onto the supporting pier blocks much more gently to thereby minimize wear on these parts. Further, this floating action minimizes the surface scratches and defects in the billets as a result of the contact between the billets and their stationary supports.

The operation of the invention will now be described with reference to FIG. 9. The walking beam conveys billets **10** along the length of the furnace chamber until the end billet in the line trips switch **156**. This switch, or internal billet position sensor, signals the controller **162** which, responsive to that signal sends a signal to a motor speed control **168**. The motor is switched to a slower speed until the walking beam reaches the bottom of its throw. At that position, a walking beam vertical position sensor will signal the controller to this effect. The controller **162** then signals the motor speed control **168** to stop the motor, thereby bringing the walking beam to rest in its lowermost position. The controller **162** then sends a signal to the billet sensor rod control of valve **186** in order to retract rod **178**.

When a billet is required at the extrusion press, the operator activates the billet demand **166** for the controller **162**. A signal is then sent from controller **162** to a door control for the exit door **122**. Responsive thereto, the door is then opened. The controller **162** signals the motor speed control **168** to move the walking beam **48** at a slow speed upon to its uppermost position. When it reaches this uppermost position, the walking beam vertical position sensor signals the controller **162** which, responsive thereto, signals the motor speed control **168** to stop the movement of the motor. The controller **162** then signals the billet retriever control or valve **148** to move the billet retriever **124** into the furnace. The billet retriever **124** continues to move into the furnace until the end billet is supported by the retriever. At that point, a retriever sensor will signal the controller which then signals the billet retriever control (valve **148**) to stop the movement of the billet retriever **124** and reverse its direction. The retriever **124** moves out of the furnace until the billet contacts the external billet position sensor or limit switch **143** which signals controlelr **162** responsive thereto. The controller **162** will then signal the billet retriever control **148** to stop the movement of the billet retriever **124**. The controller **162** then signals the retriever billet unloader to move the billet from the billet retriever **124** to the extrusion press.

The controller **162** then signals the motor speed control **168** to start the motor at its high speed to begin the movement of the walking beam **48** once again.

The conroller **162** then signals the billet sensor rod control **186** to move the rod **178** into its upper position. The cycle then begins again.

The retriever sensor can be any suitable means to sense the position of the billet on the retriever **124**, such means being disclosed and claimed in said U.S. Patent 3,415,393. Alternately, the retriever sensor could be a limit switch associated with the retriever **124** to permit the retriever to enter the furnace a predetermined distance.

The walking beam vertical position sensor can be limit switches associated with the walking beam or with the eccentric drive mechanism.

The door control can be any suitable mechanism for raising and lowering the door upon response from a signal.

The retriever billet unloader can be any suitable device for removing the billet from the retriever **124** external of the furnace. Such devices have been discussed hereinbefore.

The furnace of the invention finds particular utility in heating high copper alloys for extrusion wherein the required temperature is in the range of 2000 to 2200° F. at such temperatures most metals and their alloys have little or no strength and oxidize rapidly. Thus, conventional billet heating furnaces in which metal is used for structural parts within the furnace are not suitable. By the construction of the novel furnace according to the invention, refractory parts are used exclusively within the furnace for structural purposes, except at the exit end where the high temperature burners are not present. The structural metal beam parts are protected from heat by the refractory walls and by the water cooled portions of the beam. The cooling of the beam gives a high degree of dimensional stability to the support I beam **48**. This dimensional stability is desirable in minimizing the stress on the refractory blocks **40** as the temperature within the furnace changes.

The single walking beam structure facilitates sealing the furnace from ambient air. At the high temperatures at which the furnace operates, significant amount of oxidation can take place on the billets if the furnace is not properly sealed. The illustrated heat and air seal between the side walls and the walking beam is just one such seal which can be provided in the furnace between the walking beam and the walls. Many other types of heat seals will be suggested to those skilled in the art.

The slow movement of the billets upwardly as well as horizontally facilitates more accurate temperature measuring of the billets. The temperature of the billets are usually sensed by fixed optical pyrometers which read only a small area of any given billet within the furnace. With the slow movement of the billets in their undulating motion, the pyrometer can take an average reading over a larger surface area than on a stationary billet. Erroneous errors due to surface irregularities are thereby minimized.

Whereas the invention has been described with reference to a furnace having upper and lower rows of burners spaced along the sides, it is within the scope of the invention to employ only a single row of burners in a furnace. A single row of burners would be more appropriate in such a walking beam furnace in which smaller billets were to be heated.

Whereas the discharging mechanism has been described as operating when the walking beam has stopped, it is within the scope of the invention to withdraw the end billet while the walking beam is moving, for example, at

a slow speed. The retriever device can be synchronized to enter the furnace when the walking beam reaches a certain position in its cycle. An option point in the cycle is at the top of the throw.

Reasonable variation and modification are possible within the scope of the foregoing disclosure and the drawings without departing from the spirit of the invention.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. In a walking beam furnace having:
a longitudinal furnace chamber with an entrance end and an exit end;
a walking beam extending through said furnace chamber for moving billets therethrough;
means to drive said walking beam through an orbital path to move said billets from said entrance end to said exit end;
means for retrieving heated billets from the exit end of said furnace;
the improvement which comprises:
said retrieving means comprising a billet support member having a forward wedging means;
means to advance said retrieving means into said exit end of said furnace to force a heated billet at said exit end up onto said support member, and to withdraw said billet from said exit end of said furnace after said billet has fallen onto said billet support member; and
means to reduce the speed of said walking beam prior to the movement of said retriever means into said furnace.

2. A walking beam furnace according to claim 1 wherein said drive means includes a two-speed motor and control means are provided to operate said retriever means when said drive means is operating at a slower speed.

3. A walking beam furnace according to claim 2 wherein said control means synchronizes said retriever means to move into the exit end of said furnace to retrieve said billet when said walking beam reaches its uppermost position.

4. A walking beam furnace according to claim 1 further comprising control means to synchronize said retriever means to move into the exit end of said furnace to retrieve said billet when said walking beam reaches a predetermined position in its cycle.

5. A walking beam furnace according to claim 1 wherein said walking beam forms an upwardly opening channel at an end portion thereof in said exit end of said chamber; and said billet support member is shaped to fit within said channel.

6. In a walking beam furnace having:
a longitudinal furnace chamber with an entrance end and an exit end;
a walking beam extending through said furnace chamber for moving billets therethrough;
means to drive said walking beam through an orbital path to move said billets from said entrance end to said exit end;
means for retrieving heated billets from the exit end of said furnace;
the improvement which comprises:
said retrieving means including a billet support member having a forward wedging means for raising the forward end of said billets upwardly until they fall onto said support member;
means to advance said support member into said furnace until said heated billet falls onto said support member; and
means synchronizing the movement of said billet support member into said furnace when said walking beam is at a predetermined position.

7. A walking beam furnace according to claim 6 wherein said predetermined position is the uppermost position of said walking beam in its orbital path.

8. In a walking beam furnace in which billets are heated to temperatures in excess of 2000° F. said furnace having:
a longitudinal furnace chamber with an entrance end and an exit end;
a walking beam extending through said furnace chamber for moving billets therethrough;
means to drive said walking beam through an orbital path to move said billets from said entrance end to said exit end;
said walking beam comprising refractory members having an upper surface for supporting and positioning said billets;
the improvement which comprises:
a U-shaped channel supported on said walking beam at said exit end of said furnace, said channel forming a support for said billets at said exit end of said furnace;
retriever means having a forward wedging means mounted at said exit end of said furnace, said retriever means being shaped to fit between said U-shaped channel; and
means to move said retriever means into said furnace to wedge a billet onto said retriever means, and to move said retriever means out of said furnace, thereby removing an end billet from said furnace.

9. A walking beam furnace according to claim 8 wherein said U-shaped channel is made from a high temperature metal.

10. A walking beam furnace according to claim 8 wherein burners are spaced along the walls of said furnace chambers from said entrance end to said U-shaped channel, and said exit end of said furnace at said U-shaped channel is free of heating burners.

11. A walking beam furnace according to claim 8 further comprising control means to synchronize the movement of said retriever moving means with the movement of said walking beam such that said retriever means only enters said furnace when said walking beam is in a predetermined position.

12. A method for removing a heated billet from the end of a walking beam furnace, said method comprising:
supporting billets on a walking beam within a heating zone;
moving said billets through said heating zone on said walking beam and into an exit end of said furnace;
advancing a retriever member into said exit end of the furnace, and by said retriever member, raising the billet until it falls onto said retriever members;
removing the billet and the retriever member from the heating zone; and
synchronizing the movement of the retriever member with the movement of the walking beam such that said billet retriever is permitted to move into said heating zone only when said walking beam is in a predetermined position in its cycle.

13. A method according to claim 12 wherein said predetermined position is the uppermost position of the cycle of said walking beam.

14. A method according to claim 12 further comprising the step of sensing the presence of a billet at said exit end of said furnace, and stopping the movement of said walking beam responsive to the sensed presence of said billet at said exit end of said furnace.

15. In a walking beam furnace having:
a longitudinal furnace chamber with an entrance end and an exit end;
a walking beam extending through said furnace chamber for moving billets therethrough;
spaced support means along the sides of said furnace chamber and adjacent said walking beam to support billets thereon;
means to drive said walking beam through an orbital path to move said billets from said entrance end to

said exit end such that said walking beam moves above and below said spaced support means;

means for retrieving heated billets from the exit end of said furnace;

the improvement which comprises:

sensing means at said exit end of said furnace to sense the presence of a billet at a predetermined position at said exit end of said furnace, and to generate a signal responsive to the presence of said billet at said predetermined position; and

control means to stop said drive means responsive to said signal from said sensing means when said walking beam is in a predetermined position in its cycle.

16. A walking beam furnace according to claim **15** wherein said predetermined position is the bottom of said walking beam cycle at which position, said billets rest on said spaced supporting means.

17. A walking beam according to claim **16** wherein

said control means actuates the movement of said retriever means to remove a billet from said exit end of said furnace chamber; and said control means actuates said drive means to move said walking beam to a second predetermined position prior to the movement of said retriever means into said exit end of said furnace.

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