Jan. 20, 1970 J. W. COOK 3,490,621

WORKPIECE DISTRIBUTION SYSTEM

Filed Jan. 16, 1968 4 Sheets-Sheet 1

FIG. 1A.

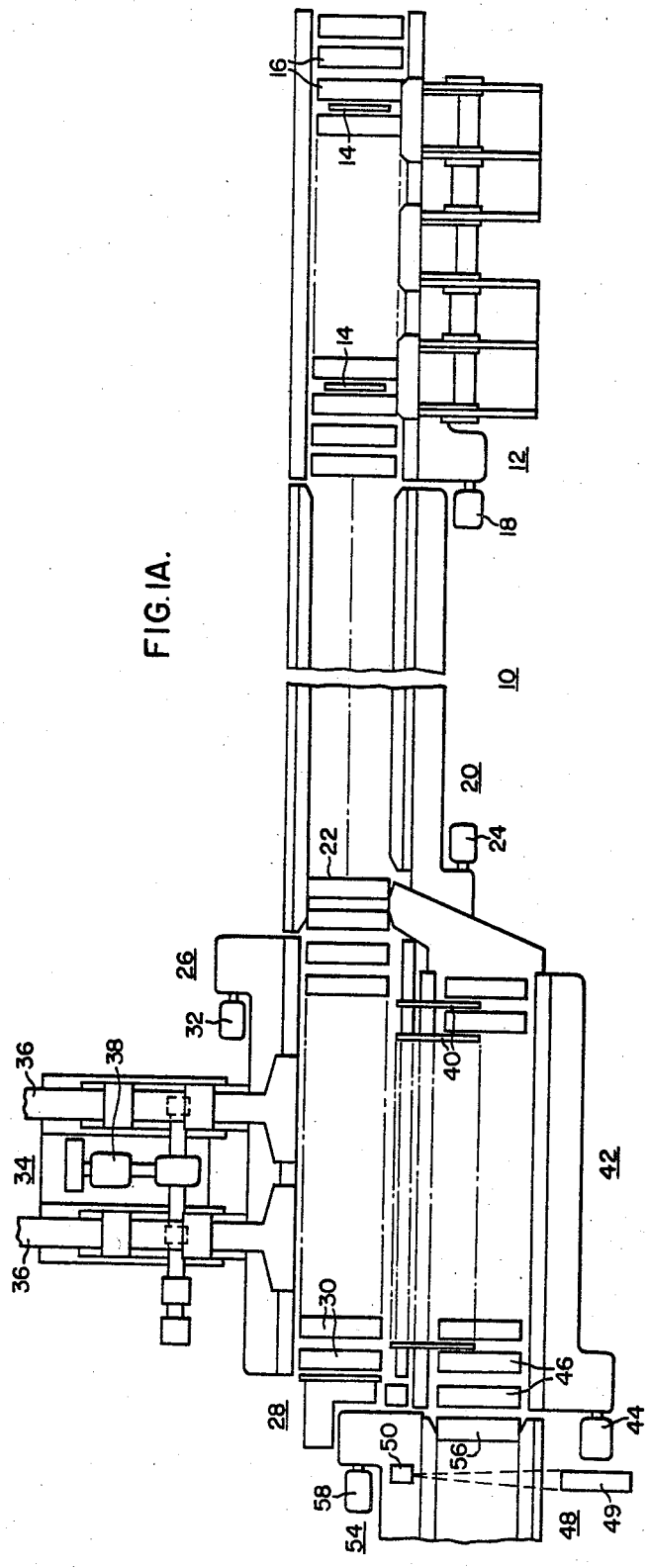
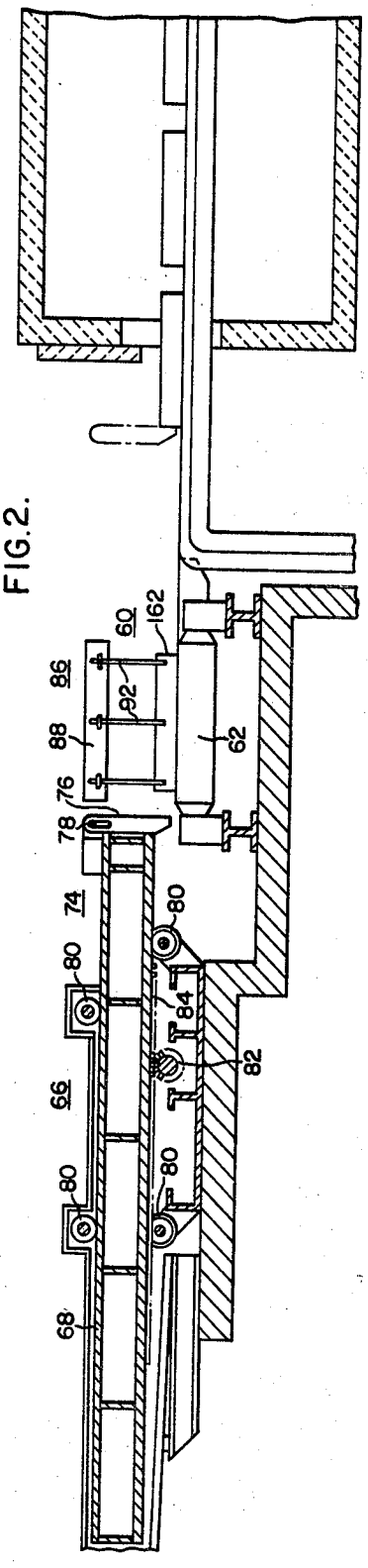


FIG. 2.



Jan. 20, 1970 J. W. COOK 3,490,621

WORKPIECE DISTRIBUTION SYSTEM

Filed Jan. 16, 1968 4 Sheets-Sheet 2

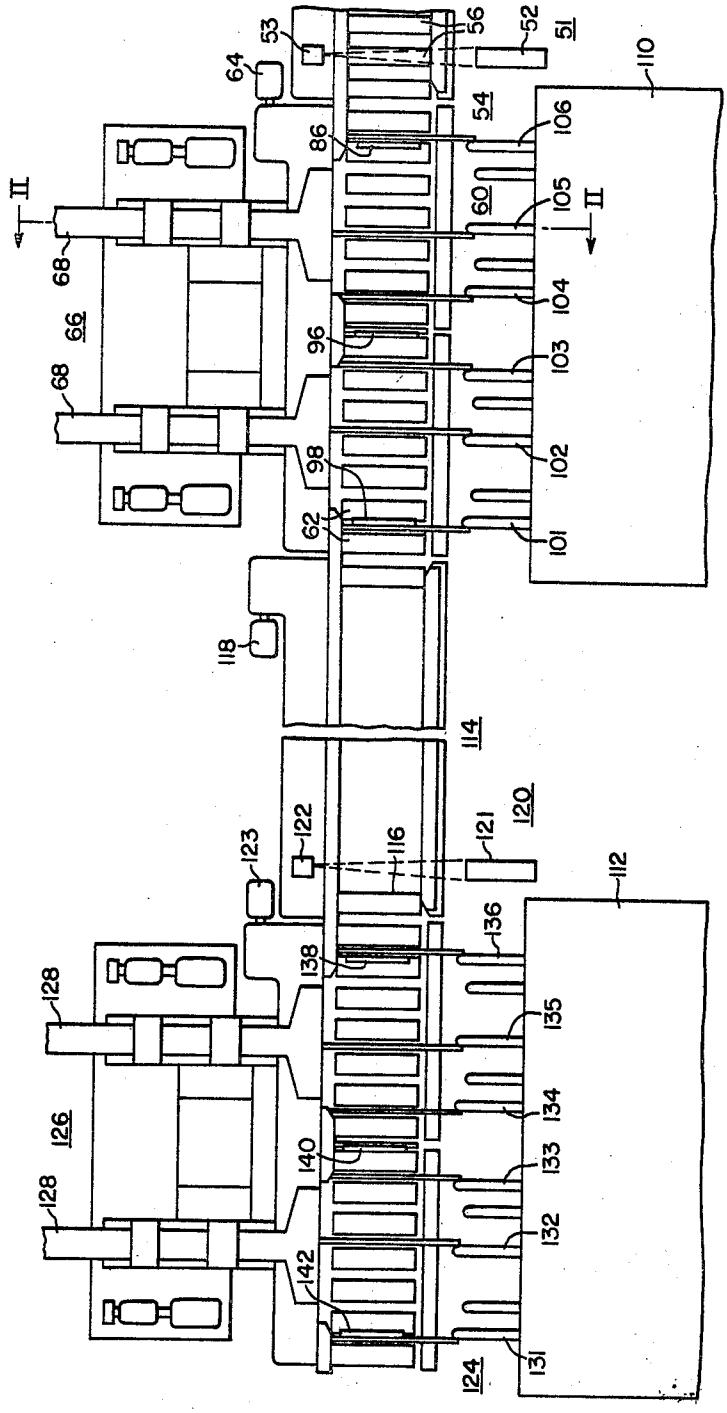


FIG. 1B.

WITNESSES

Theodore F. Wrobel

James F. Young

INVENTOR

John W. Cook

BY

R. Lewis Hecker

ATTORNEY

WORKPIECE DISTRIBUTION SYSTEM

Filed Jan. 16, 1968 4 Sheets-Sheet 3

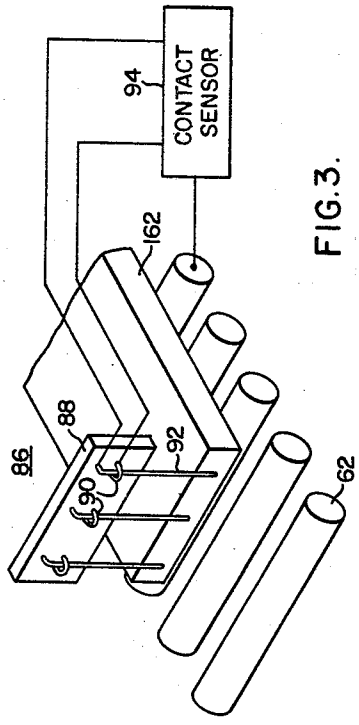
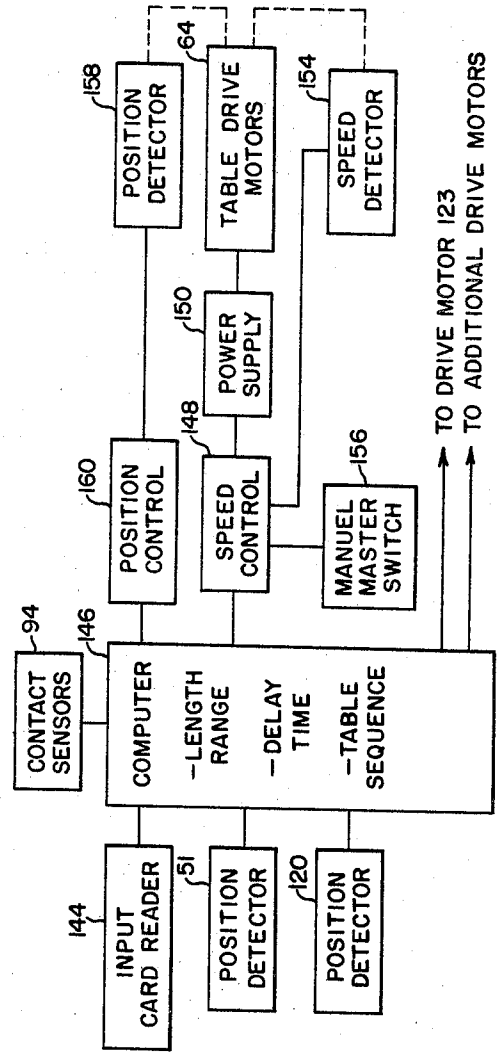


FIG. 3.

FIG. 5.



Jan. 20, 1970 J. W. COOK 3,490,621

WORKPIECE DISTRIBUTION SYSTEM

Filed Jan. 16, 1968 4 Sheets-Sheet 4

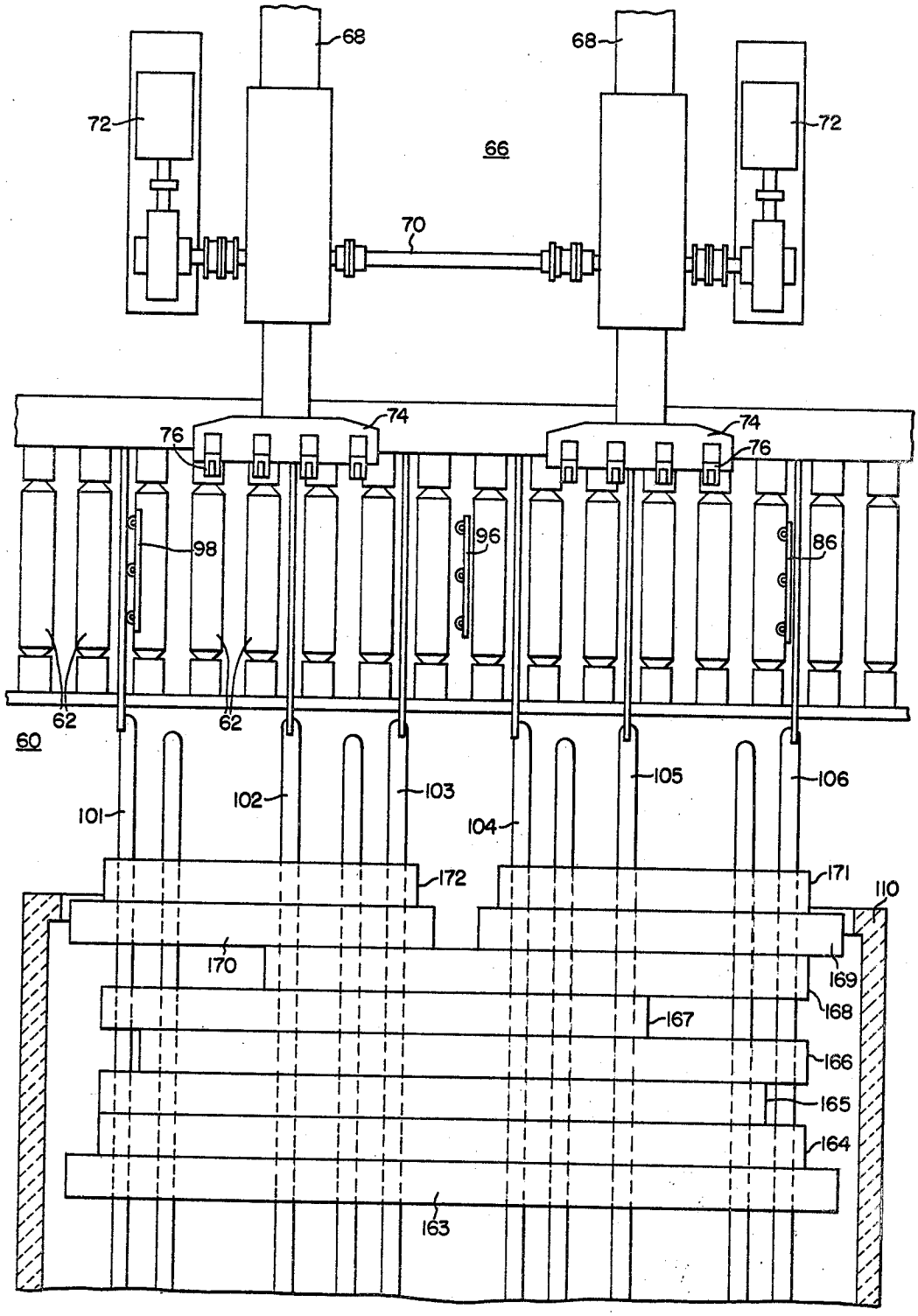


FIG. 4.

United States Patent Office 3,490,621
Patented Jan. 20, 1970

3,490,621

WORKPIECE DISTRIBUTION SYSTEM

John W. Cook, Williamsville, N.Y., assignor to Westinghouse Electric Corporation, Pittsburgh, Pa., a corporation of Pennsylvania

Filed Jan. 16, 1968, Ser. No. 698,241
Int. Cl. B65g 47/42
U.S. Cl. 214—23 10 Claims

ABSTRACT OF THE DISCLOSURE

This invention relates to a system for accurately positioning workpieces or slabs that are to be disposed within a furnace of a hot strip rolling mill. The furnace into which the workpieces are to be disposed has a plurality of skids or support members upon which the workpieces are disposed and are directed through the furnace. Typically, the workpieces are slabs of steel in a variety of length ranges and must be disposed evenly within the furnace to provide even heating and to prevent damage to the skids. The workpiece handling system includes a furnace charging table with rollers and a motor for driving the rollers, and a plurality of position detectors disposed along the length of the furnace charging table to successively detect the position of the slabs as they are driven along the length of the table. Further, suitable control means including a storage facility for storing the length of the slabs to be handled is associated with the position detectors and with the drive means for the table to accurately position each of the slabs with respect to the skids and the furnace.

BACKGROUND OF THE INVENTION

Field of the invention

This invention relates to a workpiece handling system for accurately placing a plurality of workpieces or slabs, and more particularly to a system for accurately placing a plurality of slabs to be distributed evenly within a furnace of a hot strip rolling mill.

Description of the prior art

In the typical hot strip steel mill, workpieces or slabs, which have been previously rolled from ingots or directly cast, are taken to the hot strip steel mill where they are converted from slabs to a coil of the steel strip. Typically, the slabs are taken to the hot strip steel mill in piles where they are sorted and arranged to be sent through a heating furnace in preparation to being rolled into a long strip. More specifically, the pile of slabs is first depiled and the slabs are sent singly to the furnaces along a series of tables.

In actual practice, the slabs come in a variety of ranges of lengths and are carefully positioned in accordance with their length before they are placed in the furnace. The furnaces include a plurality of burners disposed evenly throughout the furnace for heating the slabs to a temperature of approximately 2350° F. The heating process may require several hours to evenly heat each of the slabs throughout its thickness. It is desired to place the slabs evenly throughout the furnace so that the thermal load placed upon the burners by the slabs is approximately even to achieve the most efficient thermal exchange between the furnace and the slabs. It may be understood that if the slabs were not evenly spaced throughout the furnace, that portions of the slabs would not be heated enough whereas other slabs or portions thereof would be overheated. Further, the support members or skids upon which the slabs are slid through the furnaces are subject to warping at the high temperatures

of the furnaces if an even weight distribution is not placed on the skids.

In addition to the problem of presenting an even heat absorbing load to the furnaces, it is necessary to displace the ends of the slabs from the skids. Often in the processing of the slabs before they are positioned within the furnaces, the ends of the slabs are very rough and would have a tendency to cut or otherwise damage the furnace skids.

It has been typical of the prior art practice here for the operator to perform the desired positioning of the slabs into the furnace. The operator is normally not placed in a proximate position to the furnace charging tables and must view the placement through television monitors. The placement is achieved by the operator moving the slabs back and forth on the furnace charging table by driving the rollers in either direction. Such an operation is a time consuming one requiring much of the operator's time and attention.

It is therefore an object of this invention to provide a new and improved workpiece handling system for accurately positioning a series of workpieces or slabs in accordance with their length so they may be more advantageously distributed for processing.

SUMMARY OF THE INVENTION

These and other objects are accomplished in accordance with the teachings of the present invention by providing a new and improved workpiece or slab handling system including a table with a plurality of rollers which are driven by a suitable motor, a plurality of detectors for sensing the position of a slab as it is moved across the table, and a control means into which is fed data corresponding to the length of the slabs and which is responsive to the position detectors. In response to the input stored data, the control means directs the drive motor to decelerate and to bring a slab to a predetermined position on the table. The position detectors indicate those points at which the workpiece should be decelerated and provide a reference point with which the slabs should be placed. After a slab has been positioned, suitable means are provided for removing the slab from the table onto a plurality of skids which lead to the next processing area such as a furnace. The next slab is then positioned on the table in a manner dependent not only upon its length but also upon the previous position of the first slab in order to provide a distributed load to the furnace.

DESCRIPTION OF THE DRAWINGS

These and other objects and advantages of the present invention will become more apparent when considered in view of the following detailed description and drawings, in which:

FIGURES 1A and 1B are plan views of a slab entry system including the positioning system of this invention;

FIG. 2 is a sectioned view of the furnace charging table and position detector in accordance with this invention taken along line II—II of FIG. 1B;

FIG. 3 is a view of a position detector in its operative relationship to a slab;

FIG. 4 is a plan view of the furnace charging table, showing the relative position of the position detectors and the slabs with regard to the skids; and

FIG. 5 is a schematic diagram of the control system which operatively interrelates the position detectors and the drive motor in accordance with the teachings of this invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawings and in particular to FIGS. 1A and 1B, there is shown an illustrative embodi-

ment of a slab entry system **10** in which the workpiece position distributing system of this invention is incorporated. A plurality of workpieces or slabs are brought as by a suitable overhead crane and disposed in a pile upon a slab receiving table **12**. The slab receiving table **12** includes a plurality of rollers **16** which are driven through a suitable gearing by a drive motor **18**, and a plurality of slab lowering cradles **14** disposed between the rollers **16**. The slab lowering cradles **14** are normally extended when the pile of slabs are brought down upon the slab receiving table **12** in order to prevent injury to the rollers **16**. Next, the pile of slabs is conveyed to a depiler assembly **26** by suitable piler entry tables **20**, which includes a plurality of rollers **22** driven by a drive motor **24**. The depiler assembly **26** includes a depiler table **28** and a pusher assembly **34** for removing a single slab from the pile and displacing it onto a first furnace charging table **42**. The depiler table **28** includes a plurality of rollers **30** which are driven by a suitable drive motor **32**, and serves to receive the pile of slabs at a first level corresponding to that of the depiler entry tables **20** and to move the pile slabs through incremental steps corresponding to the thicknesses of the slabs so that the pusher assembly **34** may slide the topmost slab onto the first furnace charging table **42**.

The pusher assembly **34** includes a pair of pushers **36** which are driven in a reciprocal, rectilinear motion by a suitable drive motor **38**. The pushers **36** displace the topmost slab onto a plurality of skids **40** disposed between the rollers **30** and the first furnace charging table **42**. The first furnace charging table **42** includes a plurality of rollers **46** and a suitable drive motor **44** geared thereto. As shown in FIG. 1A, the plurality of skids **40** are disposed between the rollers **46** and serve to prevent the slabs from pushing against the ends of the rollers **46** and also to allow the slabs to be gently lowered onto the table **42**. For a further description of the structure and operation of the depiler assembly, reference is made to a copending application (W.E. 39,111) by the same inventor and assigned to the assignee of this invention and which is entitled "Slab Handling Apparatus," Ser. No. 698,223 and filing date Jan. 16, 1968.

After the slabs have been depiled, they may be individually driven from the first charging table **42** onto a second furnace charging table **54** including a plurality of rollers **56** driven through a suitable gearing by a drive motor **58**. The exit of a slab from the first charging table **42** is sensed by a position detector **48** illustratively including a radiation sensor **49** and a source **50** of radiation for emitting a beam across the second furnace charging table **54** onto the sensor **49**. A second position detector **51** is disposed at the other end of the second furnace charging table **54** which initiates a signal, as will be explained later, to stop the drive motor **58** when the slab has reached this point. The second position detector **51** includes a radiation sensor **52** such as a photocell and a source **53** for directing a beam of radiation across the second furnace charging table **54** onto the radiation sensor **52**.

A slab will be brought, as explained above, from the slab receiving table **12** through the depiler assembly **26** to the end of the second furnace charging table **54**, where it is held until one of the furnaces **110** or **112** may accept an additional slab. The slab upon command will be brought from the second furnace charging table **54** onto a third furnace charging table **60** which includes a plurality of rollers **62** driven through a suitable gearing by a drive motor **64**. If the furnace **110** disposed adjacent the third furnace charging table **60** is in need of additional slabs, the slab will be brought to its correct position upon the third furnace charging table **60** and will be slid by a pusher assembly **66** onto a plurality of support members or skids **101** to **106** associated with the furnace **110**.

If it has been determined that furnace **110** is not to receive the next slab, the slab will be passed from the third furnace charging table **60** to a fourth furnace charging table **114** having a plurality of rollers **116** which are driven by a motor **118**. The fourth furnace charging table **114** will convey the slab to the fifth furnace charging table **124**, where the slab may be positioned and slid into the second furnace **112**. The fifth furnace charging table **124** includes a plurality of rollers **125** which are driven by motor **123**. Similarly, the fifth furnace charging table **124** is associated with a pusher assembly **126** including a pair of pushers **128** which may be driven forward to slide the slab onto a plurality of skids **131** to **136** which are directed along the length of the furnace **112**.

Referring now to FIG. 2, a side view of the pusher assembly **66** is shown. The pusher assembly **66** includes a pair of pushers **68** which are supported by a plurality of rollers **80** to be driven in a reciprocal, rectilinear motion. Each of the pushers **68** include a rack **84** whose teeth mesh with a pinion gear **82**. As shown in FIG. 4, the pinion gears **82** are connected to a drive shaft **70** which is driven by a pair of motors **72**. As shown in FIGS. 2 and 4, the pushers **68** have a head assembly **74** from which are suspended a plurality of teeth **76** by pins **78**. A slab shown in FIG. 2 is disposed upon the table **60** and is designated by the numeral **162**. When the pushers **68** are driven forward, the teeth **76** will abut against the slab **162** to slide the slab **162** onto skids **101** to **106**. The pushers are now withdrawn to their initial position as shown in FIG. 2. It is noted that the teeth **76** are suspended upon the pins **78** to allow the teeth to rotate counterclockwise as shown in FIG. 2 if they strike an object such as another slab upon their retracting cycle.

Referring now to FIG. 4, there is shown the relative position of a plurality of slab detectors **86**, **96** and **98** with respect to the third furnace charging table **60**. The first slab detector **86** is disposed in line with the skid **106**, the second slab detector **96** is disposed centrally of the table **60** and between the skids **103** and **104**, and the detector **98** is disposed in line with the skid **101**. As shown in FIG. 3, the slab detector **86** includes an insulating support member **88** from which are suspended a plurality of flexible members or pigtails **92**. The pigtails **92** are made of a suitable electrically conductive material such as a woven steel which will withstand the repeated contact with the slabs **162**. When the slab **162** is driven by the rollers **62** to contact the pigtails **92**, an electrical circuit will be completed with a contact sensor **94**, which in turn will provide a signal indicating that the slab **162** is now passing a particular point on the third furnace charging table **60**. A first circuit is established with the contact sensor **94** through the pigtails **92**, the slab **162** and the rollers **62**. A second circuit is formed with the contact sensor **94** through a plurality of conductor rings **90**, which are disposed upon the insulating support **88**, and the pigtails **92**. Thus, when the slab **162** strikes the pigtails **92**, two parallel circuits will be closed, and the contact sensor **94** will provide an indication of the position of the slab **162**.

Further, a second set of slab detectors **138**, **140** and **142** are disposed above the fifth furnace charging table **124** in a similar manner to that described above. More specifically, the slab detector **138** is aligned with the skid **136**; the slab detector **140** is disposed centrally of the table **124** and the furnace **112**; and the slab detector **142** is aligned with the skid **131**. Further, a third position detector **120** is disposed at the end of the fourth furnace charging table **114** to control the entry of the slabs **162** onto the fifth furnace charging table **124**. Illustratively, the position detector **120** may include a radiation sensor **121** and a source **122** for emitting a beam of radiation across the fourth furnace charging table **114** onto the sensor **121**. It is noted that the slab detectors **96**, **98**, **138**, **140** and **142** are similar to the detector **86** shown and described with respect to FIG. 3.

Referring now to FIG. 4, there will now be explained in detail the process of positioning a slab or workpiece upon the third furnace charging table **60**. After a slab has been positioned upon the table **60**, the pusher as-

sembly **66** will be driven forward by the motors **72** to slide the slab from the table **60** onto the skids **101** to **106**. It is the relative position of the slab with respect to the skids **101** to **106** that is significant, and it is desired to position a series of slabs as shown in FIG. 4 to present an even heat distribution to the furnace **110** and to avoid pushing the roughened edges of the slabs along one of the skids **101** to **106**. The slabs to be heated in the furnace **110** come in three ranges of length, listed as follows:

Range	Length	Width	Thickness
A	32'8" to 36'	18" to 78"	5" to 12"
B	26'10" to 30'10"	18" to 78"	5" to 12"
C	13'6" to 17'	18" to 78"	5" to 12"

The desired distribution of the slabs upon the skids **101** to **106** is shown in FIG. 4 to provide the desired heat loading upon the furnace **110**. The ranges of slab lengths as given above are typical of those that are normally used in practice. Slabs of a length in range A will be centered with respect to the furnace **110** and with respect to the third furnace charging table **60**. Slabs of a length in range B will be staggered in the furnace with a fixed offset from the skids **101** and **106**. The short or double row slabs having a length in range C will be positioned in double rows and will be centered approximately on the quarter lines of the furnace **110** with a varying overhang on the skids **101** and **106**.

In order to handle the slabs as rapidly as possible, the slabs are transported by the first and second furnace charging tables **42** and **54** at a high rate of speed, illustratively 450 feet per minute (f.p.m.). The slabs conveyed by this system may weigh in the range of 4000 to 100,000 pounds. In order to minimize variations in the stopping distance due to variations in the wk^2 and possible changes in the coefficients of the friction between the slabs and the rollers **62**, the final stop will be made from a relatively slow, constant speed. Illustratively, the slow speed from which the stop will be initiated will be 60 f.p.m. Assuming a deceleration rate of 240 f.p.m./sec., the stopping time required will be .25 second and the distance traveled will be 1.5 inches. Due to a delay in conveying the signal between the slab detectors and the drive motor **64**, the stopping distance required from the slow speed will be in the order of two inches. Thus, each of the slabs regardless of size will be conveyed at a high rate of speed and will be decelerated to a constant slow speed so that each of the slabs regardless of mass may be accurately positioned with respect to the skids.

Illustratively, a first slab **163** having a length of 36' is to be positioned initially in the furnace **110**. Referring to FIG. 4, it can be seen that the slab **163** is to be centered with respect to the centerline of the furnace **110**. The slab **163** will be brought to the third furnace charging table **60** at full speed and will remain at this speed until the leading edge of the slab **163** is sensed by the slab detector **96**. At this point the slab **163** will be decelerated to the slower, creep speed of 60 f.p.m. The slab **163** will proceed to the slab detector **98**. When the slab detector **98** is contacted, a time delay will be provided between the contact and the initiating of the stopping action by the motor **64**. In one illustrative embodiment of this invention, the skid **101** is spaced 372" from skid **106**. As stated above, approximately two inches is required to stop a slab from a speed of approximately 60 feet per minute. In order to center the slab **163** having a length of 36', it is necessary to allow the slab **163** to overhang the skids **101** and **106** by 32". Thus, the time delay must be of sufficient duration to allow 30" of the slab **163** to pass after the position detector **98** has been contacted; this delay period would take approximately 2.5 seconds. As the length of the slabs in the first range varies from 36' to 32'8", the overhang of skids **101** and **106** will vary from 32" to 12" and the time delay will vary from 2.5 seconds to .85 second. A second slab **164** having an illustrative length of 32'8" will be similarly positioned and would have an overhang of 12" corresponding to a delay of .85 second. A general equation for determining the time delay TD would be:

$$TD=\frac{L-372}{2\times f.p.s.\times 12}$$

where L is slab length in inches and lies in the range between 432 inches and 392 inches.

The second or intermediate range B of slabs fall in the range between 30'10" and 26'10". As shown in FIG. 4, the slabs in this range will be staggered in the furnace **110** with successive slabs having overhangs from one of the skids **101** and **106**. The overhang across skids **101** and **106** will be a fixed value; in one illustrative embodiment, the fixed overhang may be 12". This will result in a fixed time delay between the actuation of either the slab detector **98** or the slab detector **86** and the deceleration of the slabs in this range; the delay will be approximately .85 second for an illustrative overhang of 12" assuming the stopping is from a speed of approximately 60 feet per minute. A first slab **165** of the intermediate length is to be positioned in the following manner. The slab **165** will be conveyed from the second furnace charging table **54** to the third furnace charging table **60** at a high rate of speed to contact the slab detector **96**. In response to the actuation of the slab detector **96**, the drive motor **64** will be slowed down to convey the slab **165** at the slow rate of approximately 60 f.p.m. The slab **165** will proceed to the slab detector **98** and will be stopped after a time delay of .85 second with the edge approximately 12" beyond the skid **101**. If a next slab **166** is also in the intermediate length, it will be positioned with an overhang from skid **106**. In this case, the slab **166** will proceed to the detector **96** at a top speed. The slab **166** will be slowed to a half or slow speed until it contacts the slab detector **98** at which instant, the motor **64** will be reversed to convey the slab **166** in an opposite direction until it contacts the slab detector **86**. Upon contact with the detector **86**, a time delay of .85 second will be provided and the trailing edge of the slab **166** will be disposed with an overhang of approximately 12" from the skid **106**. The first slab in a series of intermediate range B will desirably be positioned with an overhang from skid **101**. As shown in FIG. 4, the next pair of slabs **167** and **168** will be disposed with a fixed offset respectively from skids **101** and **106**.

Next, the positioning of the short slabs that lie in the third range C of 13'6" to 17" will be explained. Slabs in range C will always be charged or distributed in double rows in the furnace **110** as shown in FIG. 4, and, will always be scheduled to the furnaces in pairs. It is not necessary that the pairs of slabs have the same length and thickness; however, it is important that the pairs be of approximately the same width. When short slabs of range C are to be positioned, a first short slab **169** will be conveyed from the second furnace charging table **54** onto the third furnace charging table **60** at top speed until it contacts slab detector **86**, at which point the slab **169** will be slowed to a half speed of approximately 225 f.p.m. The slab **169** will proceed to the slab detector **96**, where the slab **169** will be stopped and conveyed back to the slab detector **86**. When the detector **86** is contacted for the second time, a time delay will be set which is a function of the slab length between the contacting of the detector **86** and the stopping of the drive motor **64**. When the time delay is completed, the slab **168** will be stopped with the slab end properly positioned, i.e., the leading edge of the slab **169** will have an overhang from the skid **104** equal approximately to the overhang of the trailing edge from skid **106**. As shown in FIG. 4, the overhang of the slab **169** having a length of 17' will be 32". The time delay TD will be a function of slab length and is defined by the following equation:

$$TD=\frac{L-144}{2\times 12}$$

where L is the slab length in inches and lies between 204 inches and 162 inches, and the separation between the skids **104** and **106** (**101** and **103**) is equal to 144 inches.

When the first short slab **169** of the pair has been correctly positioned, the pusher assembly **66** will be activated as by the operator to displace the slab **169** onto the furnace skids in order to allow a second short slab **170** to be brought to the third furnace charging table **60** and positioned. After the parking push of the assembly **66** has been completed and the pushers **68** withdrawn, the second short slab **170** is brought to the third furnace charging table **60** at high speed. When the slab **170** activates the slab detector **96**, the slab **170** will be slowed to the slow speed of approximately 60 f.p.m. and will proceed to the slab detector **98**. When the slab detector **98** has been contacted, an appropriate time delay will be set depending upon the length of the slab **170**. After the time delay has been completed and the slab stopped, it will be in the position with approximately equal overhangs from skids **101** and **103**. As shown in FIG. 4, a second pair of short slabs **171** and **172** may illustratively then be positioned and pushed onto the skids **101** to **106**. The slabs **171** and **172** are illustratively of a length 13'6" and have an overhang of 11" from their skids.

Referring now to FIG. 5, there is shown a control system which is responsive to the plurality of slab detectors to control the drive motors associated with each of the furnace charging tables. As shown in FIG. 3, the slab detector **88** is associated with the contact sensor **94** which as shown in FIG. 5 is connected to a computer **146**. It may be understood that the other detectors **96**, **98**, **138**, **140** and **142** are likewise associated with similar contact sensors which are connected to the computer **146**. An input is made to the computer **146** by an input card reader **144**. Typically, a card with dimension data of a slab is placed in the order of its processing into the card reader **144** which transfers an appropriate slab length information into a storage facility within the computer **146**. The computer **146** controls the speed, and the deceleration of the slabs in accordance with their length. The computer **146** acts to control the speed of the drive motor **64** in order to decelerate or to stop a slab through a speed control circuit **148** which provides an output signal indicative of the desired speed to a power supply **150**. Illustratively, the table of drive motor **64** could be of a variable voltage type whose speed is dependent upon the output signal of the power supply **150**.

A speed detector **154** may be suitably connected to the drive motor **64** in order to provide an output signal which is a function of the speed at which the rollers **62** and therefore a slab is being driven. The output of the speed detector **154** is applied to the speed control circuit **148** to complete a control loop to thereby insure that the table drive motor **64** is being controlled accurately to the correct speed. In addition, a manual master switch **156** may be connected to the speed control circuit **148** whereby the operator may override the commands of the computer **146** or operate the device in a manual mode to position the slabs upon the tables. The slab control circuitry may be supplemented by a position control circuit **160** which would in turn provide a feedback signal to the speed control circuit **148**. In this alternative embodiment, a suitable position detector **158** would be connected to either the drive motor **64** or the gearing associated with the rollers **62** in order to provide an output signal as a function of the number of revolutions or relative position of the rollers **62**. This position indicating signal would be fed back to the position control circuit **160** to accurately control the speed and therefore the position of the rollers drive by the motor **64**. As shown in FIG. 5, the drive motor **123** is also connected to the computer **146**. It is understood that a plurality of furnaces would normally be provided with corresponding furnace charging tables and pusher assemblies for positioning and distributing the slabs as described above. The computer **146** would also serve to sense the position of the slabs and to control the drive motors associated with the furnace tables as described above. In order to control the entry of the slabs onto the furnace charging tables **60** and **124**, respectively, position detectors **51** and **120** are disposed to detect the position of slabs on the previous furnace charging tables **54** and **114**. It may be understood that if the furnace charging tables **60** or **124** are not free of slabs, that the slabs approaching these tables will be detected and stopped before they are able to gain access to these tables.

As explained in the above identified application, the operation of the pusher assembly **26** is to furnish slabs, one at a time, to the second furnace charging table **54** to await further advancement onto the tables. When a slab reaches the sensor **51**, the slab will be brought to a halt waiting further instructions from the computer **146**. The order of charging will start with the first furnace **110** and will proceed with the second furnace **112**. Typically, there may be a plurality of furnaces, and the charging and the positioning of slabs will take place sequentially. If first the furnace **110** is selected out of service, the sequence will start with the second furnace **112**. Before the sequence of charging begins, the computer **146** will retract each of the pusher assemblies **66** and **120**. In some instances, it may be necessary for the operator to manually retract the pushers in order to initiate the automatic operation. When the first slab is brought to the second furnace charging table **54** and the position detector **51** is actuated, the computer **146** will recognize that the slab is present on the second furnace charging table **54**. This slab will be advanced to the third furnace charging table **60** and will be positioned as described above and then pushed into the furnace **110**. For the purposes of this discussion, it will be assumed that the slabs are of such dimensions that they are disposed in single rows. More specifically, the first slab will proceed to the third furnace charging table **60** where it will be slowed by the detector **96** and will proceed to actuate the detector **98**. After a computer time delay provided by the computer **146**, the first slab will be brought to rest in its appropriate position with regard to the skids **101** to **106**.

As soon as the second furnace charge table is open as determined either by the operator or the position detector **51**, the second slab will be moved onto the second furnace charging table **54**. When the first slab has been positioned upon the third furnace charging table **60**, the pusher assembly **66** will be actuated to place the first slab onto the skids **101** to **106**. The second slab will be conveyed from the second furnace charging table **54** upon the ables **60**, **114** to the fifth furnace charging table **124** to be positioned for pushing onto the skids **131** to **136**. As soon as the second slab has contacted the slab detector **142**, the third slab, which has been brought up and positioned on the second furnace charging table **54**, will be conveyed to the fourth furnace charging table **114**. As soon as the second slab has been positioned, the pusher assembly **120** will be actuated to push the second slab onto the skids associated with the second furnace **112**. If the fifth furnace charging table **124** is not open to allow the third slab to pass, the contacting of the detector **86** will initiate a slow down of the third and fourth furnace charging tables to half speed. The third slab will be stopped on the fourth furnace charging table **114** when it contacts the position detector **120** to await the clearing of the fifth furnace charging table **124** so that the third slab may proceed to the third furnace. When the third slab has left the second furnace charging table **54**, the next slab will be brought up onto the second furnace charging table **54**. If the third furnace charging table **60** is now open and the pusher assembly **66** has been retracted, the fourth slab will now be positioned on the third furnace charging table **60**. In this manner a plurality of furnaces may be charged with a minimum of effort and supervision by the operator. When the slabs have been positioned, the computer will either automatically

initiate a pushing operation or provide indication to the operator who may then visually check the position upon the furnace charging table before actuating the pusher assembly.

Since numerous changes may be made in the above described apparatus and different embodiments of the invention may be made without departing from the spirit thereof, it is intended that all matter contained in the foregoing description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

I claim as my invention:

1. A workpiece handling system including first support means for receiving a plurality of workpieces of assorted sizes, drive means associated with said support means for moving said workpieces in either a forward or backward direction upon said support means, detection means for detecting the position of said workpieces with respect to various points upon said support means, and control means including a storage facility for at least one dimension of said workpieces, said control means being responsive to said detection means for automatically decelerating said workpieces for stopping said workpieces upon said support means at a prescribed distance from said points dependent upon said stored dimension of said workpiece.

2. A workpiece handling system as claimed in claim 1, wherein said detection means senses the position of said workpiece with respect to at least first and second points upon said support means, and said control means initiates a deceleration of said workpiece from a first to a second speed as said workpiece passes said first point and provides a time delay between the time when said workpiece passes said second point and the time when said control means causes said drive means to stop said workpiece at said prescribed distance from said second point.

3. A workpiece handling system as claimed in claim 2, wherein said control means is operative to control said drive means so that said second speed is less than said first speed and is of such a magnitude that said workpieces may be stopped from said second speed within substantially the same predetermined distance regardless of the size of said workpieces.

4. A workpiece handling system as claimed in claim 1, further including second support means disposed adjacent said first support means, and displacement means for displacing said workpieces from said first support means onto said second support means.

5. A workpiece handling system as claimed in claim 4, wherein said control means disposes a plurality of said workpieces on said first support means in a predetermined manner, said displacement means is operative to substantially evenly distribute said workpieces upon said second support means.

6. A workpiece handling system as claimed in claim 5, wherein there is further included a means for heating said workpieces, with said second support means being disposed in a heat transferring relationship with said means for heating.

7. A workpiece handling system as claimed in claim 1, including second support means disposed adjacent said first support means, with said detection means sensing said workpieces at least at two points along said first support means, said second support means including at least two support members disposed transversely to said first support means adjacent said first and second points.

8. A workpiece handling system as claimed in claim 7, with said control means being responsive to said detection means for providing a delay time before activating said drive means to stop said workpieces at said prescribed distance from said points.

9. A workpiece handling system as claimed in claim 7, wherein said prescribed distance varies as a function of said dimension of said workpiece.

10. A workpiece handling system as claimed in claim 1, wherein said prescribed distance is a constant distance.

References Cited

UNITED STATES PATENTS

2,397,339	3/1946	Crosby	214—23
2,984,366	5/1961	Greller	214—11
3,242,342	3/1966	Gabar	214—11
3,254,778	6/1966	Marland et al.	214—18
3,280,950	10/1966	Magloire	198—127 XR

ROBERT G. SHERIDAN, Primary Examiner

U.S. Cl. X.R.

198—21, 24, 110