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Csapo et al.

[11] 3,733,173

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[54] **TOWER FURNACE COLLECTING MECHANISM**

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[52] **U.S. Cl.** **432/87**, 65/21, 432/5, 432/13, 432/146, 432/245

[51] **Int. Cl.** **F27b 19/00**

[58] **Field of Search** ....263/8, 21 B, 27; 65/21

[56] **References Cited**

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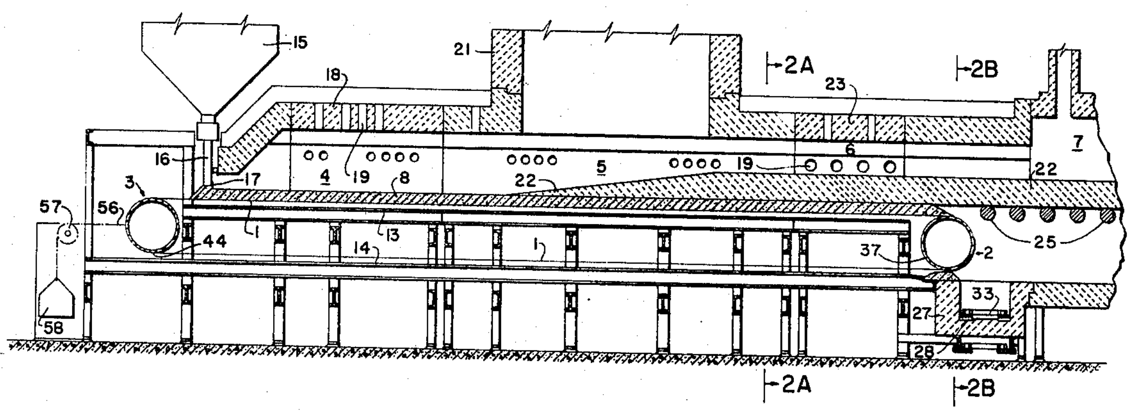
[57] **ABSTRACT**

There is disclosed an endless conveyor belt for moving hot material from under a tower furnace, with the drive from the belt having provisions to compensate for changes in the length and the width of the belt due to expansion and contraction.

7 Claims, 4 Drawing Figures



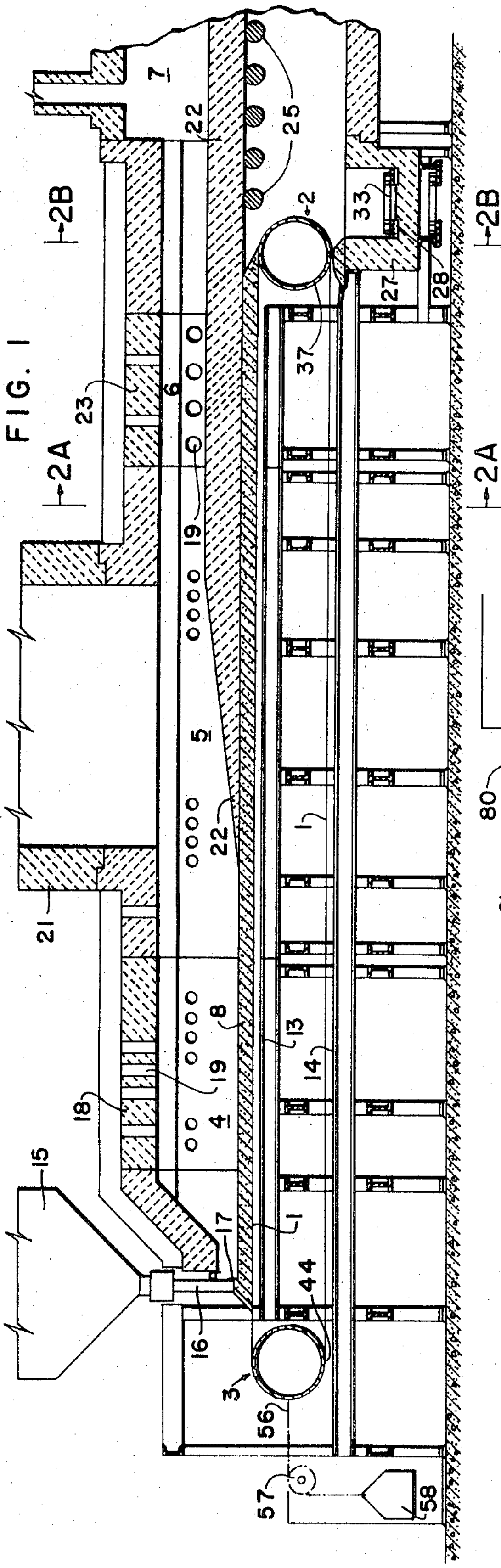


FIG. 1

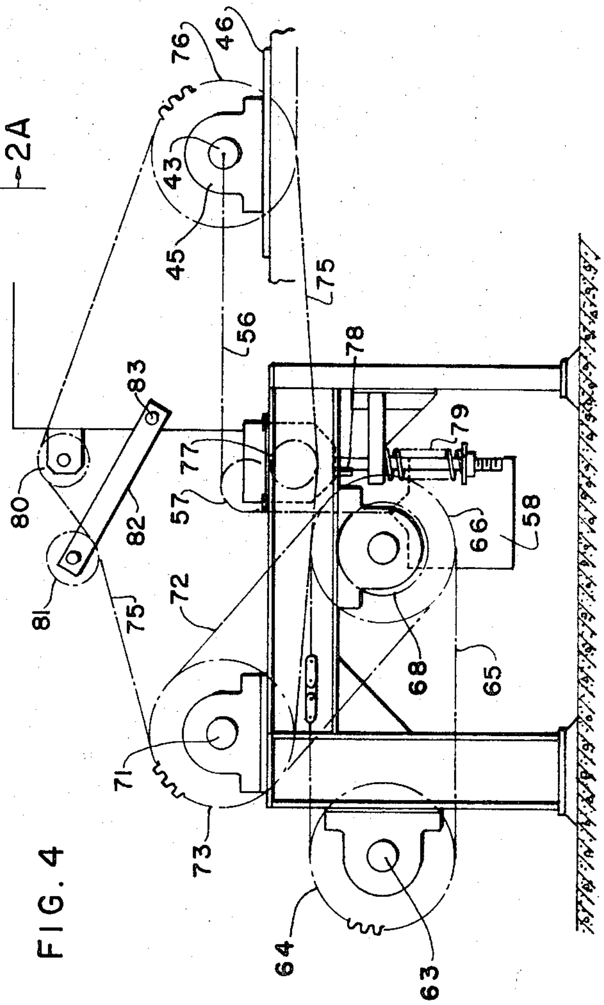
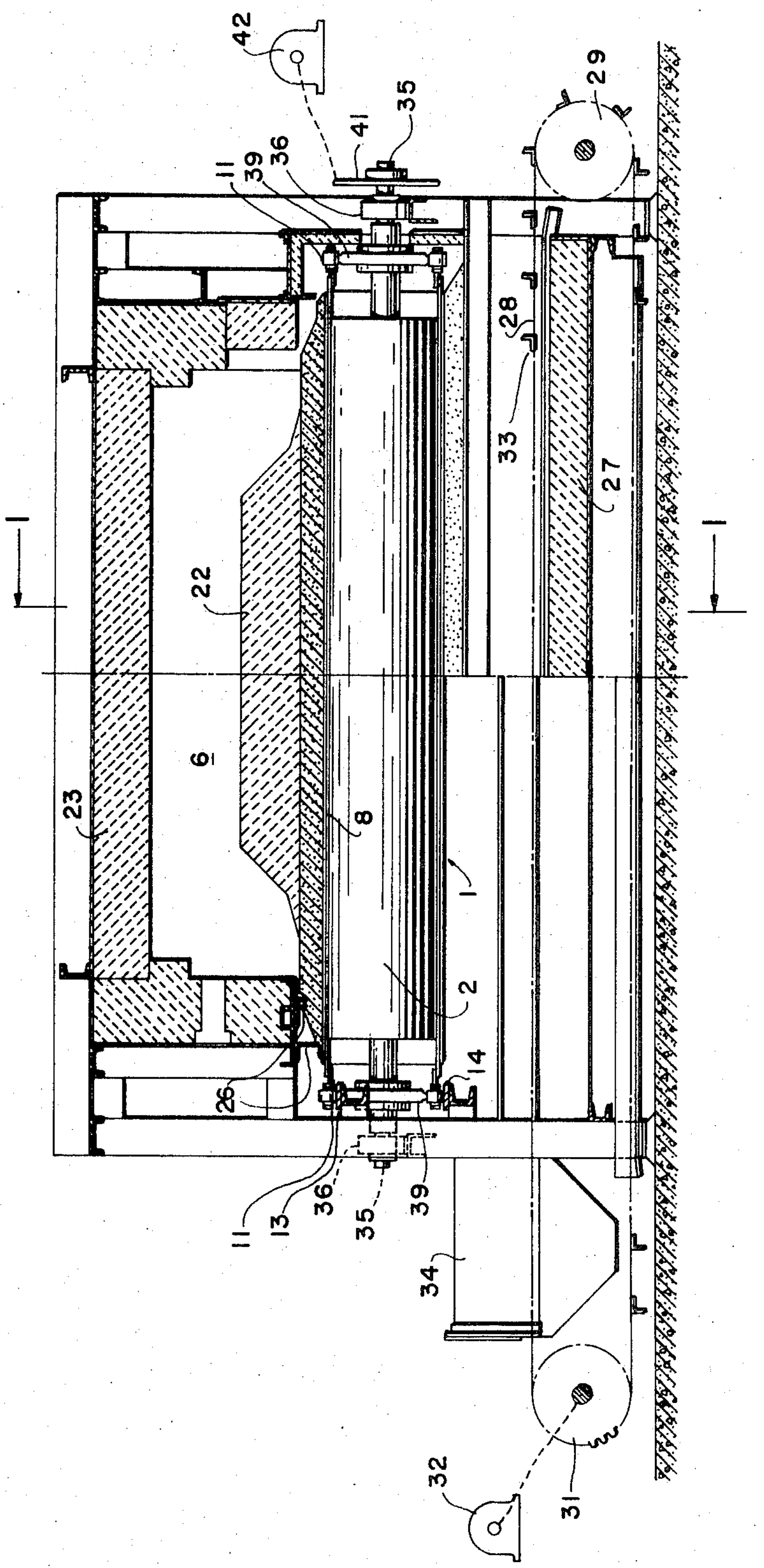


FIG. 4

FIG. 2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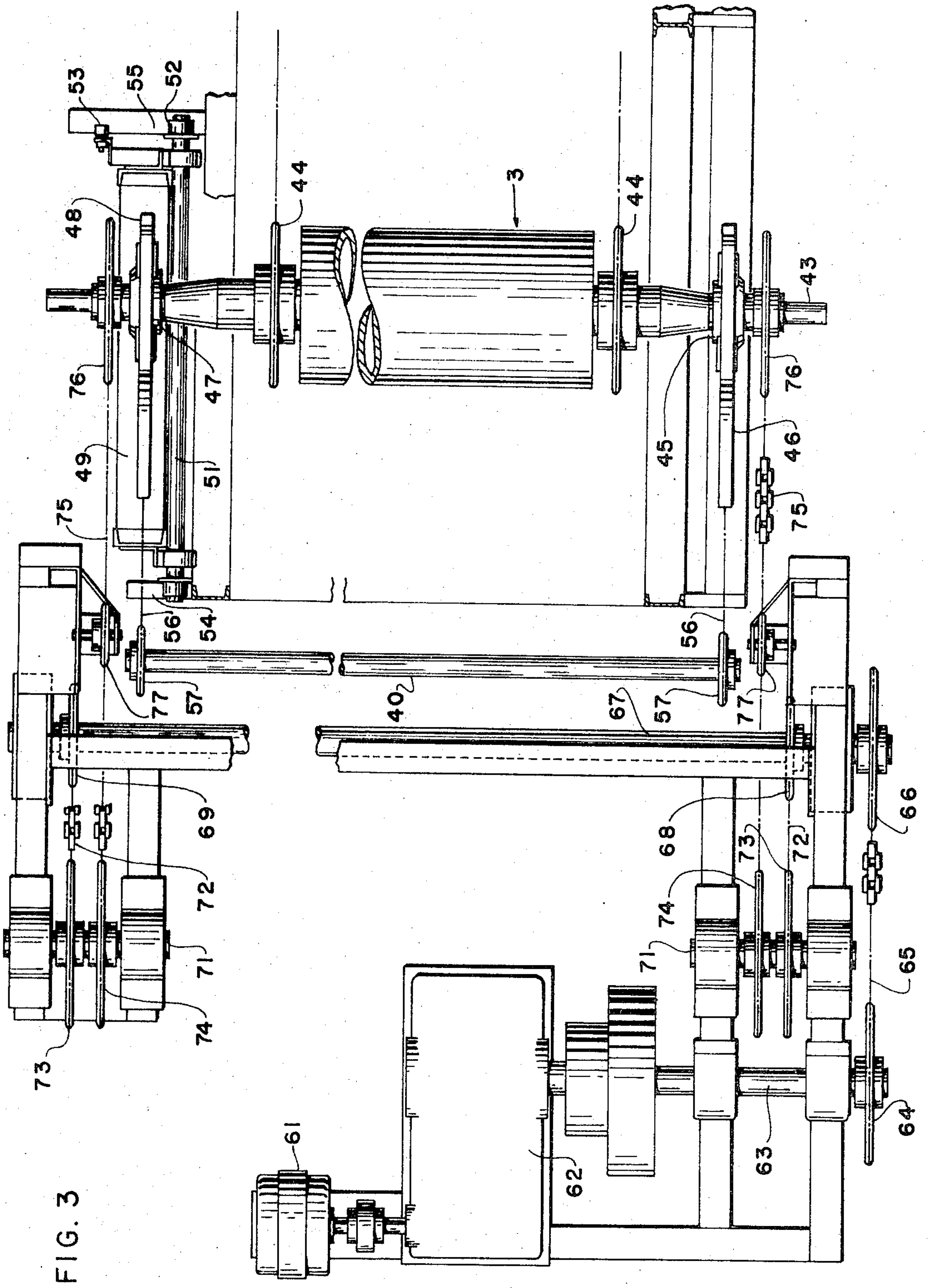
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FIG. 3

TOWER FURNACE COLLECTING MECHANISM

The present invention relates to the manufacture of ceramic foam, and more particularly to the drive mechanism for a collecting belt upon which the foam forming material is collected.

BACKGROUND

In the manufacture of ceramic foam small particles of clay or a similar bloatable material are dropped through the bloating zone of a tower furnace. As the particles fall they are bloated into individual, hollow spheres that are collected as an agglomerated mass at the bottom of the furnace. This mass is moved from under the furnace at a rate dependent upon the thickness of the slab it is desired to produce. For example, see Blaha U.S. Pat. No. 3,056,184 and Hess U.S. Pat. No. 3,240,850.

The intense heat of the particles, particularly at the location immediately beneath the furnace where they are collected, has caused difficulty with the collection apparatus. Primarily, the trouble has been due to warping and short service life of the collecting belt or conveyor.

Various dual drive mechanisms have been suggested for controlling the stresses placed in a conveyor belt. For example, U.S. Pat. Nos. 2,393,563 and 2,229,973 teach such mechanisms.

It is an object of the invention to provide collecting apparatus for use with a tower furnace that will operate indefinitely in the heat to which it is subjected.

It is a further object of the invention to provide a novel drive means for a collecting belt that is designed to operate under high temperature.

SUMMARY

There is provided a mesh belt made of a high temperature alloy that is guided around a pair of drive sprockets. One of these sprockets is driven by a variable speed drive to move the agglomerated material from beneath the furnace to an annealing oven. The other sprocket is powered by a constant torque hydraulic drive to keep the belt under tension and to compensate for any variations in length or width of the belt due to the thermal conditions to which it is subjected. There is also provided a device for depositing a parting agent and insulating material on the belt as it is moving under the furnace into collecting position.

The various features of novelty which characterize our invention are pointed out with particularity in the claims annexed to and forming a part of this specification. For a better understanding of the invention, however, its advantages and specific objects attained with its use, reference should be had to the accompanying drawings and descriptive matter in which we have illustrated and described a preferred emobdiment of the invention. In the drawings:

FIG. 1 is a longitudinal section of the apparatus taken on line 1—1 of FIG. 2

FIG. 2 is a transverse section with the left-hand portion being taken on line *2a—2a* and the right-hand portion being taken on line *2b—2b* of FIG. 1.

FIG. 3 is a top view of the tail shaft drive mechanism, and

FIG. 4 is a side view of said mechanism.

The apparatus of the invention includes an endless conveyor **1** that moves around a head roller assembly **2** and a tail roller assembly **3**, details of which will be

described later. The upper course of the belt or conveyor moves under a preheating zone **4**, a collecting zone **5**, and a solidifying zone **6** which is adjacent to and opens into an annealing zone **7**.

Conveyor **1** comprises a wire mesh belt **8** formed of a suitable alloy which will withstand the temperatures to which it is subjected. The edges of the belt are attached to roller chains **11** that are used to guide and move the belt through its path. The rollers of the roller chains on their upper course ride along guide rails **13** to hold them level in the desired plane of travel while the lower course of the belt is supported by the roller chains as they move along lower rails **14**.

Adjacent to the left end of the upper course of the conveyor belt, a parting agent is placed on this belt. To this end there is provided a supply bin **15**, the lower end of which is formed as a rectangular spout **16** of a length equal to the width of the belt. The parting agent, which is granular in form and has good insulating characteristics, flows through the spout **16** onto the belt as the latter is moving to the right. There is provided a plow **17** which smooths the upper surface of the parting agent. This plow can be adjusted vertically in order to determine the thickness of the layer of parting agent laid on the belt. As the upper course of the belt moves to the right it will move underneath a refractory structure **18** that forms the area of the preheating zone. A plurality of burners **19** are located in the side walls and roof of this structure in order to heat the upper surface of the parting agent to a temperature approaching the temperature of the material that will be collected in the adjacent collecting zone. Because of the insulating value of the parting agent, the belt itself remains relatively cool.

Collecting zone **5** is immediately below the open bottom of a tower furnace **21** of the type described in the abovementioned Blaha U.S. Pat. No. 3,056,184. As the belt with its layer of parting agent moves through the collecting zone, material falling through the furnace is collected on the parting agent. This is shown as a slab **22** of gradually increasing thickness as the belt moves to the right. The thickness of the slab that is collected will depend jointly upon the speed of the belt and the volume of material which is being dropped through the furnace. By the time the belt has reached the right edge of the collection zone, the slab is of the proper thickness. The slab on the belt then moves into a solidifying zone **6** in which the collected material forming the slab cools sufficiently so that is is selfsupporting and rigid. This zone is formed by refractory structure **23** which is built around the conveying belt. This zone may also have its temperature regulated by means of burners **19** as was the case in the preheating zone.

It will be seen, particularly in the left side of FIG. 2, that the lower edge of the side wall of structure **23** is provided with a pair of downwardly directed blades **26** which extend into the edge of the layer of parting agent. These form a "sand seal" to prevent infiltration of cooling air at the edges of the belt. A similar construction is used on the other side of structure **23** and on the sides of the structure **18** forming the preheating zone and the structure beneath the furnace forming the collection zone. Thus, the entire area, from the point of deposit of the parting agent on the belt to and including annealing zone **7**, forms a closed chamber with the belt acting as a moving floor.

Slab **22** travels on rollers **25** through an annealing zone **7** of the required length. Since the belt does not extend into the annealing zone, the structure forming this zone entirely surrounds the conveyor rolls **25** so that the slab continues to move through a closed chamber. Suitable seals are built around the ends of roll assembly **2** in order to prevent infiltration of cooling air between the solidifying and annealing zones. Thus, the slab is kept in a controlled environment from the time it is formed.

As belt **8** passes around head roller assembly **2** the parting agent will fall into a transversely extending collecting trough **27** from which it is removed by a conveyor chain **28** that passes over sprockets **29** and **31** at opposite sides of the apparatus. It is noted that the sprocket **31** is driven by a suitable motor **32.** The conveyor chains **28** are connected by pusher rods **33** that move through trough **27** to carry the parting agent and small pieces of slab that were cut from the edges to a bin **34** for disposal.

The head roll assembly **2** comprises a shaft **35** which extends across the apparatus and is journaled in bearings **36** that are mounted on the frame. This shaft has mounted on it a cylinder **37** which supports belt **8.** Shaft **35** has on it, between the bearings and the ends of cylinder **37,** sprockets **39** for roller chains **11** to which the belt is attached. Shaft **35** has on its outer end a drive sprocket **41** that is driven in a conventional manner by a variable drive speed motor **42.** This motor, by rotating shaft **35** and the parts attached thereto, pulls the upper course of the conveyor belt to the right in FIG. **1** at a constant preset speed. The head drive shaft is locked into the bearing **36** on the side driven by the motor **42.** In like manner the drive sprocket **41** and sprocket **39** on the drive side are keyed and locked to shaft **35.** To provide for axial expansion of the shaft **35** the sprocket **39** on the non-drive side is keyed but not locked to shaft **35** (i.e., it floats). Also the shaft **35** floats in bearing **36** on the non-drive end of the shaft.

The tail roll assembly **3** is of the same construction as head roll assembly **2.** This roll is provided with a shaft **43** and has provided on its sprockets **44** for the roller chains **11** of the conveyor. In order to provide for expansion of the belt in both length and width, the bearings for shaft **43** are movable. For this purpose one end of the shaft is journaled in a bearing **45** that is slideable in a guide **46** in the direction of movement of the belt. The other end of the shaft **43** is mounted in a bearing **47** that is also slideable in the direction of the movement of the belt in a guide **48.** The guide **48** is mounted on a plate **49** that has journaled at its ends and parallel thereto a shaft **51** provided with a roller **52** at each end. One end of the plate is provided with a third roller **53.** One roller **52** and roller **53** move along a track **55** while the other roller moves along a track **54.** Thus, the second mentioned end of shaft **43** is mounted in a bearing that can also move in and out as the belt and its carrying roller expand in an axial direction. Shaft **43** is biased to the left in FIG. **1** in order to take up slack in the belt as it changes in length by means of a pair of chains **56** which are attached at one end to the bearings **45** and **47** respectively and which pass over sprockets **57** with counterweights **58** fastened to the other ends. Sprockets **57** are keyed to shaft **40** to provide for weight transfer from one side of the belt to the other in the event of uneven expansion in chain **11.**

The collecting belt and its load are heavy enough so that a drive is used at both ends. The drive for the head end, driven by motor **42,** pulls the upper course of the belt, the parting agent, and the slab to the right away from the furnace. The lower course of the belt is driven by a hydraulic drive which is designed so that it, in effect, drives each end of the shaft separately. This type of drive supplies a constant pull to both chains attached to the lower course of the belt regardless of the position of the shaft, and whether or not it expands axially. This drive is powered by a motor **61** which is connected to the input shaft of a constant torque type hydraulic drive and gear box unit **62.** The output shaft of drive **62** is provided with a sprocket **64** that, through a chain **65,** drives a second sprocket **66** on a shaft **67** extending across the width of the apparatus. Shaft **67** has on it two sprockets **68** and **69,** each of which serves to drive one end of shaft **43.** The drives between shaft **67** and each end of shaft **43** are identical and similar parts will be given similar reference numerals. Sprocket **68** drives a countershaft **71** by means of a chain **72** and a sprocket **73.** A second sprocket **74** on counter shaft **71** serves, through a chain **75,** to drive a sprocket **76** on the outboard end of shaft **43.** The lower run of chain **75** is kept under a constant tension by means of an idler sprocket **77** that is mounted to rotate on the upper end of a vertical shaft **78.** This shaft is biased downwardly with a constant force by means of a compression spring **79.** The upper run of chain **75** passes over a guide sprocket **80** and has any slack in it taken up by a second idler **81** mounted on the end of an arm **82** which is pivoted at its other end to move around a fixed point **83** on the frame of the apparatus.

In operation of the system, the drive motor **61** for the tail assembly is started first to apply constant torque to the lower course of the belt without driving the upper course of the belt. The head drive motor **42** is then started and adjusted to the desired speed. Sprockets **39** on shaft **35** pull the upper course of the belt and keep it taut. As the belt starts to move, parting agent is placed on it in a layer of a thickness determined by the position of the blade **17.** The surface of the parting agent is heated as it passes through chamber **4** to a temperature substantially equal to that of the bloated particles falling onto it as it moves below the furnace **21.** The slab **22** builds up to the desired thickness and is cooled sufficiently in zone **6** to be self-supporting by the time it has reached head roller assembly **2.** Here the slab passes on rollers **25** through an annealing zone while the parting agent falls into trough **27.** This material is moved by pusher rods **33** to a collection zone where it is disposed of or treated for reuse.

The tail shaft **43** upon which sprockets **44** are mounted is driven by the hydraulic drive mechanism **62.** This drive, as explained above, is applied equally and separately to both ends of shaft **43.** Thus, as the belt changes in length and width, due to expansion and contraction, weights **58** will take up the increase in length. Drive chains **75** are acted on by spring-biased sprockets **77** so that the chains are under constant tension and will serve to transmit the same torque to the sprockets **76** on the ends of shaft **43** even if one edge of the belt should expand more than the others. Thus, the upper course of belt **5** is driven by head shaft **35** at a fixed speed by its drive motor **42.** The lower course of belt **5** is driven at a speed depending upon the speed of the upper course and is maintained at a constant tension which takes into account the changing length of the belt. Driving the endless belt from both ends of its path of travel reduces the tension under which the belt must be placed and insures that there will be no tendency for the drive to bind.

The parting agent is placed on the upper surface of belt in a thick enough layer so that the insulating effect of the agent prevents the belt from being overheated.

The area above the belt surrounding the slab is actually a closed chamber with the belt forming the floor and whose temperature can be accurately controlled. Since the space between and below the courses of belt is open to the air, and may be force cooled, if desired, the various metal parts are kept well below the temperature they are designed to withstand with a consequent increase in their useful life.

While in accordance with the provisions of the Statutes we have illustrated and described the best form of embodiment of our invention now known to us, it will be apparent to those skilled in the art that changes may be made in the form of the apparatus disclosed without departing from the spirit and scope of the invention set forth in the appended claims, and that in some cases certain features of our invention may be used to advantage without a corresponding use of other features.

What is claimed is:

1. In combination with a tower furnace having an opening in the bottom thereof, collecting mechanism to collect material dropped through said opening comprising an endless belt having an upper and a lower course moving horizontally beneath and to both sides of said furnace, a pair of drive rolls around which said belt is guided, first drive means connected to drive one of said drive rolls to move the upper course of the belt at a fixed speed to move material from under said furnace, a sprocket attached to each end of the other drive roll, a second drive means operative to exert a constant torque, and means to connect said second drive means individually to said sprockets to exert a constant torque to the lower course of said belt in a direction opposite to the direction of movement of the upper course.

2. The combination of claim 1 including means to mount said other drive roll for movement in the direction of movement of said belt to compensate for changes in length thereof, and means to bias said mounting means to take up any slack in said belt.

3. The combination of claim 1 including structure cooperating with said belt at each side of said furnace forming a chamber over said belt, means to deposit a layer of insulating material on said belt in advance of said structure, and means to heat said structure on both sides of said furnace.

4. The combination of claim 3 including a trough extending across said structure beneath said belt at said one side of said furnace into which the insulating material will fall as said belt moves around its roller, and means to remove the insulating material from said trough.

5. The combination of claim 1 including a shaft upon which said other drive roll is mounted, a sprocket on each end of said shaft, said second drive means including a chain individually to rotate each sprocket, and means to maintain the driving portion of each chain under a constant tension.

6. In combination, a first and a second spaced and substantially parallel rolls, means to mount said first roll for rotation around its axis, means to drive said first roll at a selected constant speed, means to mount said second roll for rotation around its axis, an endless belt extending around said rolls with its upper course moving through a plane at a given level, means to deposit a layer of material on said belt to be moved through said plane, structure including a top and downwardly extending sides over the upper course of said belt to form a chamber with the belt the floor thereof, the sides of said structure including a portion extending into the layer of material on said belt to seal the space between said sides and said belt, means to adjust the mounting means for said second roller toward and from said first roller, and constant torque drive means for said second roller.

7. The combination of claim 6 including burners in said structure to heat said chamber.

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