Feb. 24, 1970 K. W. FORSTER ET AL 3,497,089

APPARATUS AND METHOD FOR CHARGING A FURNACE

Filed Sept. 29, 1967

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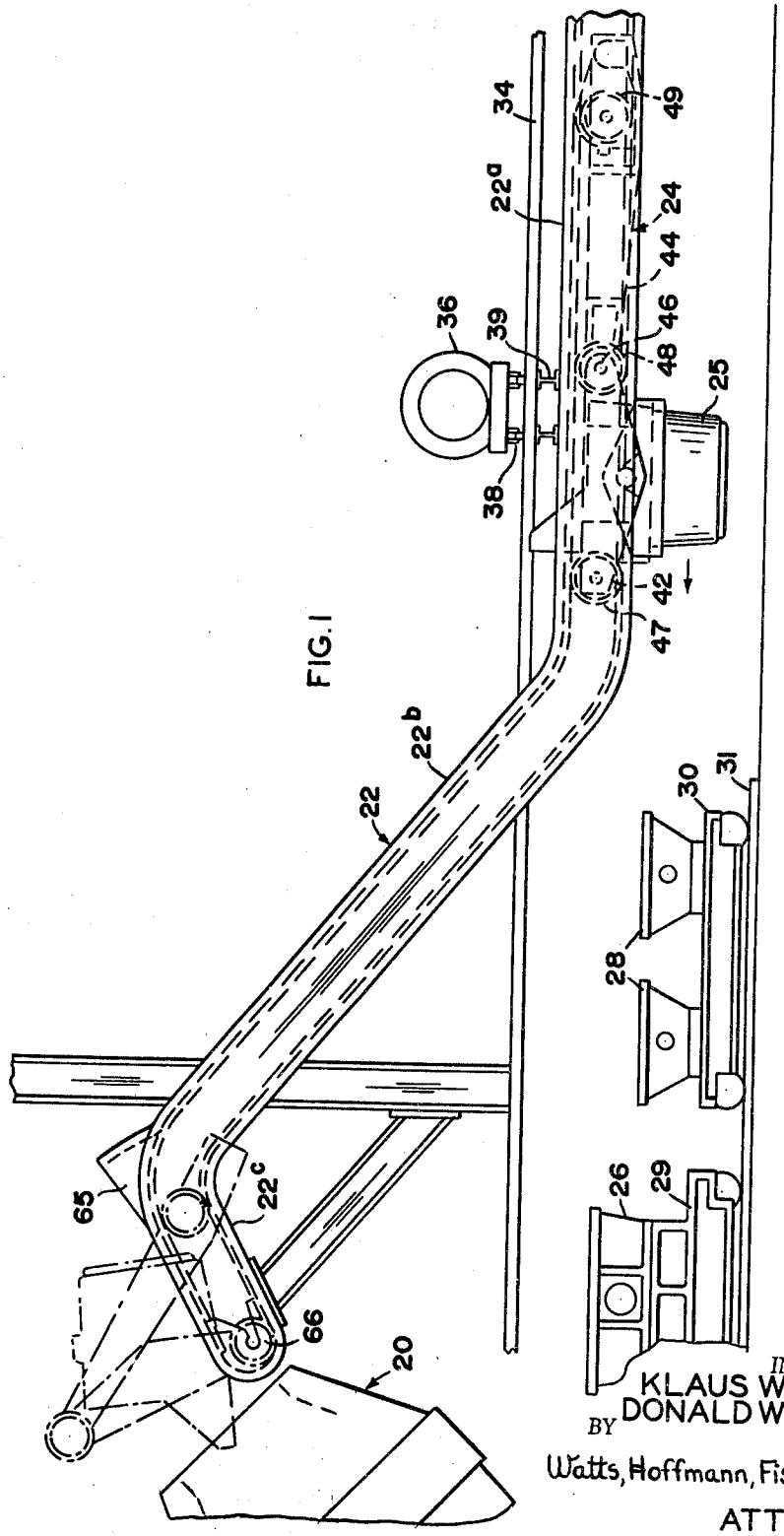


FIG. 1

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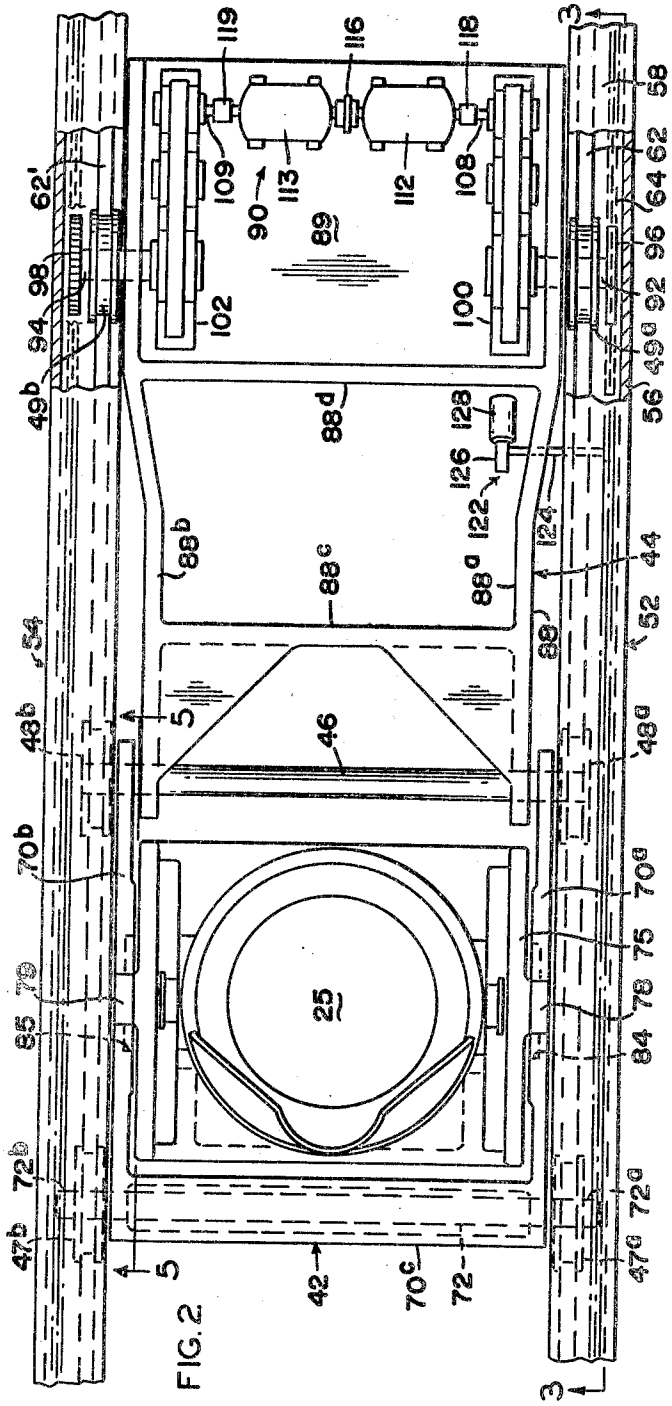


FIG. 2

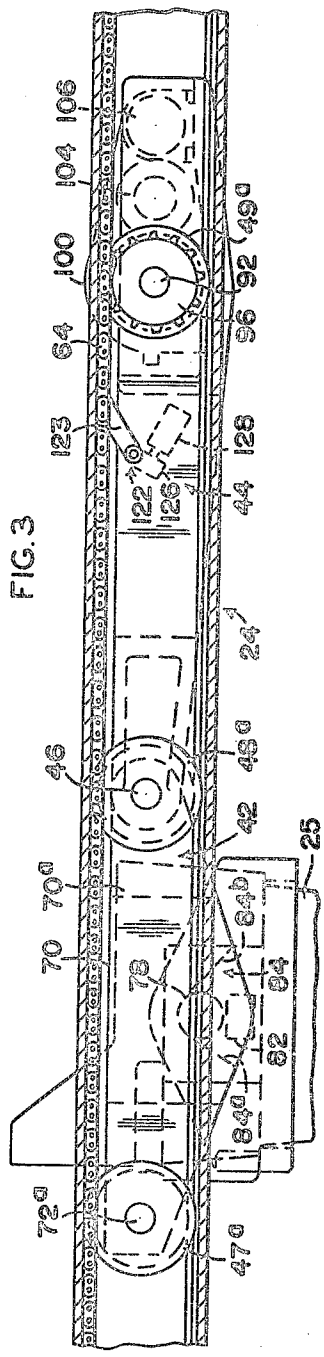


FIG. 3

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FIG. 4

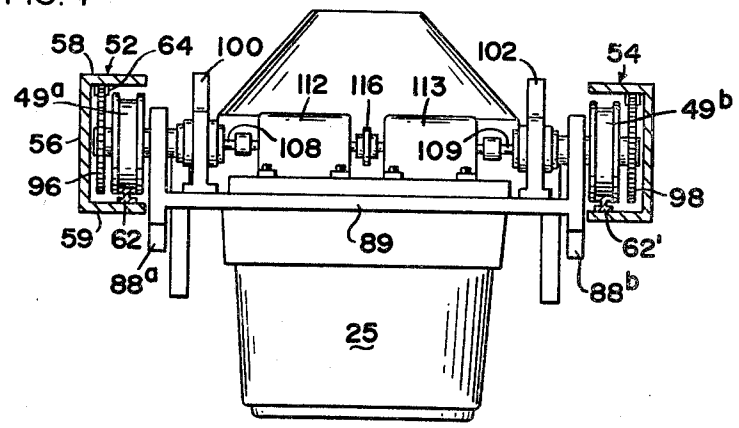


FIG. 5

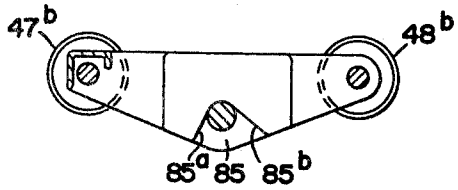
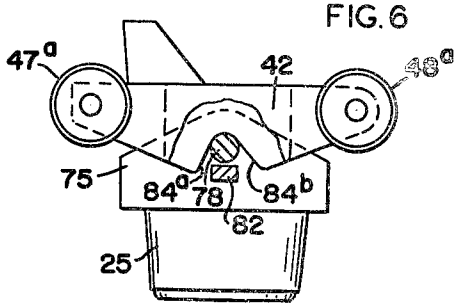


FIG. 6



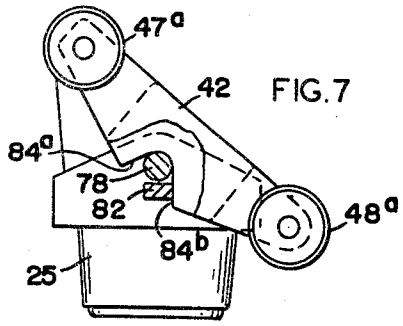


FIG. 7

FIG. 8

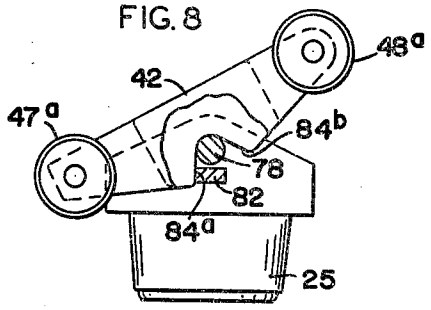
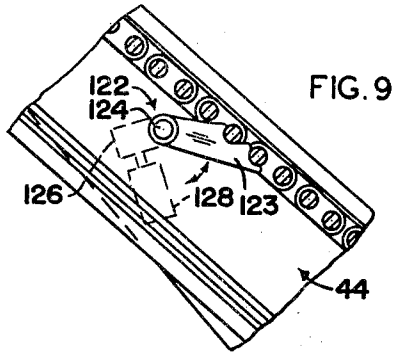


FIG. 9



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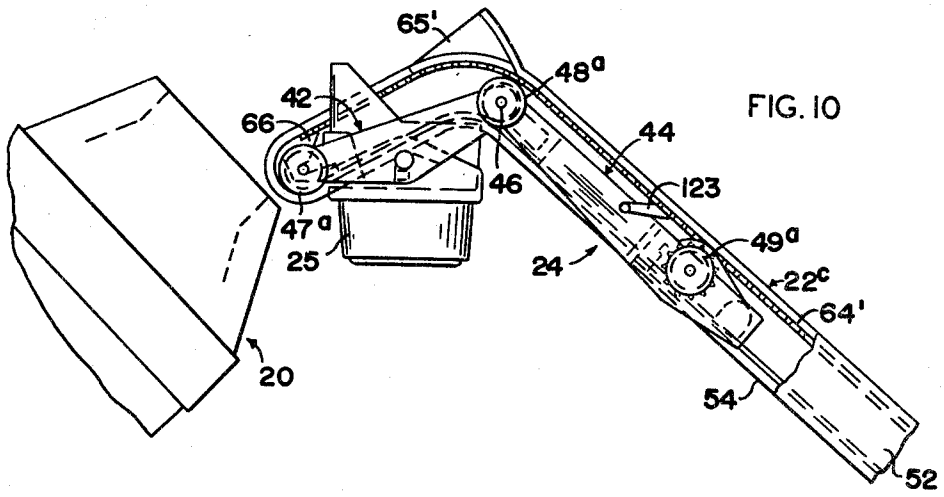


FIG. 10

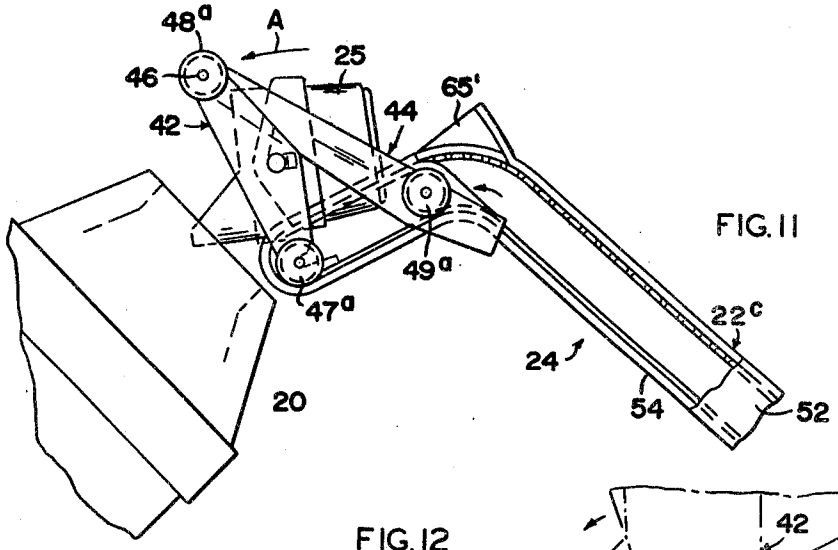


FIG. 11

FIG. 12

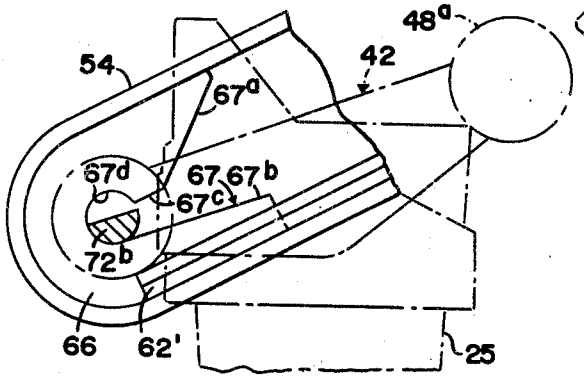
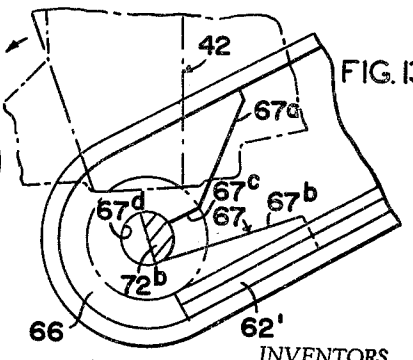


FIG. 13



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APPARATUS AND METHOD FOR CHARGING A FURNACE

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Int. Cl. B66c 17/08; E01b 25/22; B61d 15/12
U.S. Cl. 214—19 7 Claims

ABSTRACT OF THE DISCLOSURE

An articulated carriage with tandem sections is supported and guided by a track for movement to a location above a steel-making furnace, preferably of the basic oxygen type. A forward carriage section carries a charge container and a following carriage section drives the carriage along the track. Forward movement of the front section is stopped above the furnace and continued movement of the trailing section jack-knifes the carriage, tilting the front section and charge container forward. A portion of the track above the furnace is angularly inclined downwardly relative to a preceding portion of the track to initiate tilting of the front section of the carriage.

This invention relates to apparatus and methods for charging a furnace, especially for charging a steel-making furnace of the basic oxygen type.

In accordance with the present invention, economical apparatus is provided that will carry a charge to a steel-making furnace and discharge the charge with minimal direct operator control. To this end, a track and an articulated carriage movable along the track are provided which carry a charge container, such as a ladle, and automatically tilt the container at a proper location to introduce the charge to a furnace. One important feature of this invention is that the tilting of the container is accomplished by the movement of the carriage along the track, eliminating the need for separately controlled means for conveying the charge and tilting the charge container. Also, the rate at which a charge, such as molten iron, is discharged from the container can be controlled. It is therefore a principle object of this invention to provide an articulated carriage for carrying material to be charged into a furnace along a guided track, wherein the carriage is tilted by changing the relative angular relationship of two sections of the carriage about a horizontal axis in response to movement of the carriage along the track in order to introduce a charge to a furnace.

It is another object of this invention to provide a carriage, as described above, which includes a pivotal support for the charge container to permit the container to remain vertical while the carriage sections travel along inclined portions of a track, and stop members on the carriage that limit the pivotal movement of the montainer relative to the carriage so that the container is tilted when the carriage is tilted beyond a predetermined angle.

Another object of this invention is to provide a track for a carriage as described above, in which the track terminates in a downwardly inclined portion that initiates relative pivoting of the two sections of the articulated carriage. In the preferred construction, the track includes two side-by-side guide members, each including a track surface and at least one including a rack means for engagement with cogs or teeth of a drive wheel of the carriage.

It is a further object of this invention to provide for the efficient and convenient charging of a steel-making furnace by supporting a carriage on wheels on opposite ends of the carriage and adjacent a transverse pivotal axis intermediate the ends, to carry a charge in a container by said carriage along a track to a furnace, and to introduce the charge by stopping the front of the carriage while continuing to drive a trailing portion of the carriage to raise the transverse pivotal axis and central portions of the pivoted section of the carriage from the track so as to forwardly tilt the front section of the carriage.

Yet another object of the invention is to provide a stop means at the end of the track where the carriage is tilted as described above to engage and stop the front section of the carriage while the trailing portion continues to move and to prevent movement of the front section along the track in either direction when the front section is tilted relative to the track.

These and other objects, features and advantages of the present invention will become more apparent from the following detailed description, when considered in conjunction with the accompanying drawings, in which:

FIGURE 1 is a diagrammatic, partial elevational view showing a carriage and track constructed and arranged in accordance with the present invention and the adjacent environment of a steel-making furnace;

FIGURE 2 is a top plan view of the horizontal track portion and carriage of FIGURE 1;

FIGURE 3 is a longitudinal sectional view through a track member of FIGURE 2, taken along the line of 3—3 and looking in the direction of the arrows, and showing the carriage in side elevation;

FIGURE 4 is an end elevational view taken from the right-hand side of FIGURE 3;

FIGURE 5 is a sectional view taken along the line 4—4 of FIGURE 2 and looking in the direction of the arrows, showing details of the ladle car of the carriage;

FIGURE 6 is a side elevational view of the ladle car of FIGURE 2 with portions broken away, showing constructional details of a ladle ring carried by the ladle car;

FIGURE 7 is a diagrammatic view of the ladle car and ladle of FIGURE 6 showing the manner in which the ladle ring and ladle can pivot relative to the car;

FIGURE 8 is a diagrammatic view similar to FIGURE 7, showing the manner in which the ladle ring and ladle can pivot in an opposite direction relative to the ladle car from that shown in FIGURE 7;

FIGURE 9 is a fragmentary side elevational view taken along a plane similar to that of FIGURE 3 through an inclined portion of the track to illustrate a safety ratchet carried on the carriage;

FIGURE 10 is a partial side elevational view with a portion of one track guide member removed, illustrating the position of the carriage and ladle at the terminal end of the track adjacent a furnace, prior to tilting the ladle;

FIGURE 11 is a side elevational view similar to FIGURE 10, illustrating the manner in which the ladle car and ladle are tilted to introduce a charge to a steel-making furnace;

FIGURE 12 is a partial side elevational view, with a part in section, of the terminal end of a track member viewed from the inside, illustrating details of a stop member for engaging and holding an axle of the carriage, and specifically showing the manner in which a portion of the axle is received prior to tilting of the carriage; and

FIGURE 13 is a partial elevational view similar to FIGURE 12 illustrating the manner in which an axle portion of the carriage is retained by the stop member when the ladle car is tilted.

(A) GENERAL ARRANGEMENT

A general arrangement of a furnace charging apparatus constructed in accordance with the present invention is shown in FIGURE 1 of the drawings. The apparatus is shown in connection with a conventional steel-making furnace vessel **20**, and includes a track **22** and an articulated carriage **24** that carries a ladle **25** along the track from a loading area at which the carriage is shown in solid line, remote from the furnace, to a charging station above the furnace vessel **20**, where the carriage and ladle are shown in phantom.

The furnace vessel **20** is of the type used in the basic oxygen process and is shown tilted to receive a furnace charge. The furnace can be further tilted after the charge is processed to discharge its contents into one or more ladles **26** and slag pots **28**, which are carried on transfer cars **29**, **30**, respectively, on a track **31** at a level below the furnace vessel **20**.

The track **22** that carries the carriage **24** includes a horizontal portion **22***a* at a first level beneath a platform support or floor **34**, an upwardly inclined portion **22***b* extending from the horizontal portion to a higher level above the furnace vessel **20**, and a terminal portion **22***c* that is inclined downwardly directly adjacent and above the furnace vessel **20** when the furnace vessel is tilted as shown in FIGURE 1 to receive a charge. A molten iron transfer ladle **36**, of the torpedo-type, is shown on tracks **38** that extend across the track **22** at the level of the platform or floor **34** above reinforcing beams **39**. The transfer ladle **36** can be moved over the track **22** at the loading area to transfer molten pig iron to the ladle **25**, which is then carried by the carriage **24** along the track **22** and charged into the furnace vessel **20**.

The carriage **24** is in two sections and comprises a ladle carriage section or car **42** and a drive carriage section or car **44**. The two carriage sections or cars are pivotally connected together in tandem by a horizontal transverse axle shaft **46** and are supported on three pairs of wheels **47**, **48**, **49** that ride on the track **22**.

(B) TRACK CONSTRUCTION

As best shown in FIGURES 2 to 4, the track **22** is constructed of two laterally spaced, side-by-side, guide members **52**, **54** in the form of channels in which the pairs of wheels **47**, **48**, **49** of the carriage **24** ride. The guide members **52**, **54** are mirror images of each other and the structure mounted on the guide members is identical for each; therefore, only the guide members **52** and associated structure will be described in detail. Corresponding parts on the guide member **54** are referred to by corresponding reference numerals, designated with a prime.

The guide member or channel **52** is formed of a vertical web **56** and upper and lower flanges **58**, **59** extending inwardly of the track. A rail **62** for supporting the wheels of the carriage **24** is mounted on the upper surface of the lower flange **59** and a chain **64**, which functions as a rack, is fixed to the lower surface of the upper flange **58**. The chain **64** is offset laterally outward with respect to the rail **62**, as best shown in FIGURES 2 and 4. At the terminal end **22***c* of the track, where the track is inclined downward, the upper flange is open at **65**. (See FIGURE 1 and the corresponding portion **65'** of the guide member **54** in FIGURES 10 and 11). The open portion **65** is located directly over the rail **62** and inwardly of the chain **64**, so that the chain **64** follows the contour of the guide member while the open portion permits the center pair of wheels **48** of the carriage **24** to move out of the guide channels **52**, **54** when the ladle car reaches the end of the track.

A stop member and latching device **66** is located in the channel members at the terminal end of the track, and serves to stop the front portion of the carriage **24** and secures it against movement along the track in either direction once the ladle car section of the carriage is

tilted relative to the track, in a manner to be further described subsequently. The device **66**, as shown in detail in FIGURES 12 and 13 is in the form of a plate secured to the inside of the vertical web of each guide member. The plate has a slot **67** having upper and lower edges **67***a*, **76***b* that converge to a minimum gap at **67***c*. The slot **67** terminates in a circular configuration **67***d* larger in diameter than the width of the gap **67***c* and which will receive the axle of the front wheels **47** of the ladle car.

(C) CARRIAGE CONSTRUCTION

The construction of the carriage **24**, which is comprised of the ladle car **42** and the drive car **44**, is best shown in FIGURES 2 to 5.

(1) Ladle car

The ladle car **42** has a frame **70** that is U-shaped in plan and formed of opposite side portions **70***a*, **70***b* and a connecting front portion **70***c*. A transverse front axle **72** is fixed in the pront portion **70***c* of the frame and rotatably supports two wheels **47***a*, **47***b* located outwardly of the frame **70**. End portions **72***a*, **72***b* of the shaft **72** extend beyond the wheels **47** and are the full diameter of the shaft longitudinally of the car but are smaller in the direction of the car height. This construction facilitates latching or keying the front axle in place at the terminal end of the track because the end portions **72***a*, **72***b* will pass through the gap **67***c* of the slot **67** in the stop member and latching device **66** when the carriage is aligned with the track. The end of the slot then contacts the axle ends, acting as an abutment to stop forward movement. Once the ladle car is tilted, as shown in FIGURE 13, the shaft **72** rotates with the car and the end portions **72***a*, **72***b* cannot move back through the gap **67***c* from the circular portions **67***d* of the latching devices **66**.

The horizontal transverse shaft **46** about which the ladle car **62** and drive car **44** pivot relative to each other, is rotatably supported at the opposite end of the ladle car from the axle **72**. Wheels **48***a*, **48***b* are rotatably supported on the carriage by this shaft and are located to the outside of the frame **70**, aligned with the pair of wheels **47**.

A ladle ring **75** is pivotally secured to the ladle car **42** and supports the depending ladle **25** in which molten iron is normally carried. The outer periphery of the ladle ring **75** is generally rectangular in plan, as shown in FIGURE 2. Stud shafts **78**, **79** extend from opposite sides of the ladle ring, are pivotally received in the side frame portions **70***a*, **70***b* of the ladle car and support the ladle ring for pivotal movement relative to the ladle car about an axis parallel with the axle **72** and pivot axle **46**. A stop member **82** in the form of a rectangular block extends from the ladle ring **75** on each side, directly beneath the stud shafts **78**, **79**. The stop members **82** extend into wedge shaped recesses **84**, **85** (FIGURES 2, 3 and 5) formed on opposite inside surfaces of the frame portions **70***a*, **70***b* of the ladle car. Each recess has inclined surfaces **84***a*, **84***b* and **85***a*, **85***b* respectively, which form an apex adjacent the stud shafts and function as inclined abutment surfaces that cooperate with the stop members **82** when the ladle car is inclined beyond a given angle with the horizontal.

The manner in which the ladle and ladle ring freely swing within the limits of the abutment surfaces so that the ladle ring is normally maintained in a horizontal position is best illustrated in FIGURES 6, 7 and 8. The ladle car **42** is illustrated in a horizontal position in FIGURE 6, corresponding to an orientation along the track section **22***a*. In FIGURE 7, the ladle car is shown at an angle incline with the horizontal, as when the ladle car is moved up the inclined portion **22***b* of the track **22**. FIGURE 8 illustrates the angle of the ladle car **42** when supported by the track at the terminal portion **22***c*. In each of the positions shown, the ladle remains level. It will be ap-

parent from FIGURE 8 that further tilting of the ladle car **42** in a counterclockwise direction about the forward axle **72** will tilt the ladle **76** by virtue of the cooperation between the stop member **82** and the inclined surfaces **84***a*, **85***a* which limit relative pivotal movement between the ladle ring and car once the car is tilted to the position shown in FIGURE 8.

(2) Drive car

The drive car **44** is attached in tandem behind the ladle car **42** by the pivot axle **46** and is power driven to move the ladle car along the track **22** between the loading station and charging station and to tilt the ladle car and ladle at the charging station. The drive car **44** includes a frame **88** having longitudinally extending side portions **88***a*, **88***b* and cross beams **88***c*, **88***d*. The side portions **88***a*, **88***b* extend forwardly of the cross beam **88***c* and are connected to the pivot axle **46** so that the axle **46** can rotate relative to the frame **88**. The side frame portions **88***a*, **88***b* also extend rearwardly of the cross frame member **88***d* and are spanned by a flat body portion **89** that serves as a support for a drive unit indicated generally at **90**.

Two short axle shafts **92**, **94** extend through the side frame portions **88***a*, **88***b* respectively behind the cross beam **88***d* and are journaled in the side frame for rotation. A wheel **49***a* is secured to the axle shaft **92** and a wheel **49***b* is secured to the axle shaft **94**. These wheels are aligned with the other wheels **47**, **48** and ride on the rails **62**, **62'**. Each shaft **92**, **94** extends outward, beyond the wheel. A sprocket **96** is fixed to the outer end of the shaft **92**, and a sprocket **98** is fixed to the outer end of the axle shaft **94**. The inner ends of the axle shafts **92**, **94** are respectively driven by gear trains in housings **100**, **102**. Within each of these housings a driven gear (not shown) is secured to the inner end of the respective axle shaft, and an intermediate idler gear **104** connects the driven gear to a drive gear **106** (both shown in dotted lines in FIGURE 3). The drive gear **106** associated with axle **92** is driven by a shaft **108** from an electric motor **112**. The corresponding drive gear associated with the axle **94** is driven by a shaft **109** from an electric motor **113**. The drive shafts of each electric motor are axially aligned and connected by a coupling **116** between the two motors to assure that both drive at the same speed. A solenoid actuated brake **118** is provided on the shaft **108**, and a similar brake **119** is provided on the shaft **109**. The brakes **118**, **119** provide a convenient means for maintaining the carriage **24** in fixed location, especially when the ladle **25** is being filled with a furnace charge. Normally the motors **112**, **113**, in addition to driving the carriage, are used to control the speed of the carriage **24** when it moves down the inclined track section **22***b*.

A safety ratchet **122** is carried by the drive car **44** (FIGURES 3 and 9), located to cooperate with the chain **64** to prevent uncontrolled movement of the carriage down the inclined track portion **22***b*. The ratchet mechanism consists of a pawl **123** pivoted on a shaft **124** extending transversely through and journaled in the frame portion **88***a*. A counter-weight arm **126** is secured to the shaft **124** to bias the pawl **123** into contact with the chain **64**. A solenoid actuator **128** is connected with the counterweight arm **126** to pivot the pawl **123** out of contact with the chain. With this arrangement, the pawl **123** biased by the counter-weight arm **126** permits the carriage **24** to move in a forward direction from the loading station to the charging station while preventing movement of the carriage in the opposite direction, should there be a power failure that would disable the drive mechanism. When it is desired to move the carriage from the charging station back to the loading station, the solenoid **128** is energized, pivoting the pawl out of contact with the chain and permitting movement of the carriage in the opposite direction.

Electric current to operate the motors **112**, **113**, brakes **118**, **119** and solenoid **128** of the drive car **44** is supplied in a conventional manner (not shown), as by a conductor or third rail associated with the track and a collector associated with the carriage, or by flexible cables connected directly from a source of power to the drive car.

D. OPERATION

In operation, the carriage **24** is first positioned at the loading station, where it is shown in solid line in FIGURE 1. The ladle **25** is filled with a furnace charge, such as molten pig iron from a transfer ladle **36**. While the carriage is located at the loading station, the brakes **118**, **119** are actuated to prevent movement of the carriage. Once the ladle is filled with molten metal, the brakes are released and the electric motors **112**, **113** are energized to rotate the drive shafts **108**, **109** and the sprockets **96**, **98** in a clockwise direction as viewed in FIGURE 3. By virtue of the engagement of the sprockets **96**, **98** with the chain **64**, **64'**, the carriage is moved along the rails **62**, **62'** of the guide members **52**, **54** and up the inclined portion **22***b* of the track **22** toward the charging station. During this movement of the carriage, the solenoid **128** controlling the pawl **123** of the safety ratchet **122** is deenergized so that the counterweight arm **126** holds the pawl in contact with the chain **64**.

As already indicated, at the loading station the ladle car and ladle are as shown in FIGURE 6. When the carriage is moved up the inclined section **22***b* of the track, the car and ladle pivot relatively to the position shown in FIGURE 7, and when the carriage first reaches the charging station, the ladle car is positioned in the track portion **22***c* in the relationship shown in FIGURE 8. The position of the entire carriage at this time is shown in FIGURE 10 of the drawings.

As shown in FIGURE 10, when the carriage first reaches the terminal end of the track **22** the ladle car **42** is inclined downward and the drive car **44** is inclined upward, the two being pivoted about the pivot axle **46**. Extending ends **72***a*, **72***b* of the front axle shaft **72** engage the stop member **66** and prevent further forward movement of the front of the ladle car. Continued rotation of the drive sprockets **96**, **98** causes the drive car **44** to continue its movement up the inclined portion **22***b* of the track. The intermediate pair of wheels **48** leaves the track and continues in a generally upward direction through the openings **65**, **65'** in the track guide members **52**, **54**. This continued movement of the drive car causes the ladle car to pivot in a forward direction about the front axle **72** to the position shown in FIGURE 11 of the drawings. Because the stop members **82** on the ladle ring **75** prevent the ladle from pivoting clockwise, as viewed in FIGURES 10 and 11, relative to the ladle car once the car is in the position shown in FIGURE 10, the ladle is tilted with the car as indicated by the arrow A to discharge the contents of the ladle into the furnace vessel **20**.

During the tilting of the ladle car **62**, the front axle shaft **72** rotates relative to the track and is thereby secured against movement along the track by the narrow gap **67***c* of each stop member and latching device **66**. This prevents the front end of the ladle car from moving backward along the track once the car is pivoted beyond the vertical.

Once the drive sprockets **96**, **98** of the drive car reach the position along the track shown in FIGURE 11, a limit switch (not shown) stops the operation of the electric motors **112** and **113**. After a short time delay to allow the ladle to empty, the motors **112**, **113** are reversed, the solenoid **128** of the safety ratchet **122** is energized and the drive car **44** is moved back along the track **22** toward the loading station. This movement first tilts the ladle car back to the track, to the position shown in FIGURE 10, and then moves the entire carriage **24** to the position shown in FIGURE 1, where the ladle **25** can receive a subsequent charge.

From the foregoing, it will be appreciated that the present invention includes the provision of a reliable and essentially automatic incline hoist which (1) eliminates the need for a separate guide track to separately cause tilting and pouring of the charge carrier, (2) controls the rate at which the charge is poured by the speed of movement of the carriage and (3) is relatively simple and reliable in operation.

While a preferred embodiment of the present invention has been disclosed in detail, it will be readily appreciated that various modifications or alternations may be therein without departing from the spirit and scope of the invention.

We claim:

1. In apparatus for charging a steel-making furnace, a track formed of two spaced side-by-side guides extending between a first location remote from a furnace and a second location adjacent and above a furnace where the furnace is charged, said track having a portion inclined upward in a direction toward the furnace to a position higher than the furnace and a subsequent terminal portion inclined downward in a direction toward the furnace, an articulated carriage movable along the track between the two locations, said carriage having first and second sections, pivot means securing the first and second sections together for relative angular movement about an axis transverse to the direction of carriage movement along the track, said carriage extending between the two spaced guides and having wheels on opposite sides at front and rear ends of the carriage and also adjacent to or directly at the pivot means, all engageable with the spaced guides, a container for a furnace charge secured to the said first section of the carriage, a pivoted support on the first section of the carriage for the charge container, which permits the container to remain vertical while the carriage sections travel along the upwardly and downwardly inclined portions of the track, stop members on the carriages that limit the pivoted movement of the charge container relative to the carriage, drive means connected to the said second section of the carriage for moving the carriage along the track, and means to stop movement of the first section of the carriage at the terminal portion of the track without stopping movement of the second section, whereby the said pivot means and the wheels at or adjacent to the pivot means are lifted from the guides as the second section of the carriage continues to move along the track, tilting the said first section of the carriage and the container forward to introduce a charge to a furnace.

2. In apparatus for charging a steel-making furnace, a track extending between a first location remote from a furnace and a second location adjacent and above a furnace where the furnace is charged, said track having a terminal portion inclined downward relative to a preceding portion, an articulated carriage movable along the track between the two locations, said carriage having first and second sections, pivot means securing the first and second sections together for relative angular movement about an axis transverse to the direction of carriage movement along the track, a container for a furnace charge secured to the said first section of the carriage, a pivoted support on the first section of the carriage for the charge container, which permits the container to remain vertical while the carriage sections travel along the upwardly and downwardly inclined portions of the track, and a stop member on the first section of the carriage that limits the pivoted movement of the charge container relative to the carriage, means for moving the carriage along the track, and means to stop movement of the first section of the carriage at the terminal portion of the track without stopping movement of the second section, whereby the said pivot means is lifted as the second section of the carriage continues to move along the track, tilting the said first section of the carriage to tilt the container forward and introduce a charge to a furnace.

3. In apparatus for charging a steel-making furnace; a track extending between a first location remote from a furnace and a second location adjacent and above a furnace, where the furnace is charged; and an articulated carriage movable on wheels along the track between said two locations, including a first carriage section with a container for a furnace charge, a second carriage section pivotally connected thereto, and a toothed drive wheel; said track including a portion inclined upwardly toward said second location where the furnace is charged and subsequently terminating in a portion inclined downwardly, said track comprising two spaced side-by-side guides each including a track surface constructed and arranged to support and guide the carriage wheels, and at least one guide including a rack means for engagement with the drive wheel of the carriage, said guides being channel shaped with a vertical web and upper and lower transverse flanges, with the upper flange in part open at the juncture of the downwardly inclined portion and the upwardly inclined portion of the track.

4. In apparatus for charging a steel-making furnace; a track extending between a first location remote from a furnace and a second location adjacent and above a furnace, where the furnace is charged; and an articulated carriage movable on wheels along the track between said two locations, including a first carriage section with a container for a furnace charge and with key means for selectively connecting said first carriage section to a guide member, and a second carriage section pivotally connected to the first section; said track including a terminating portion inclined downwardly toward said second location and comprising two spaced side-by-side guide members each including a track surface constructed and arranged to support and guide the wheels of the carriage and at least one guide member having an open slot at the end of the terminating portion that is generally key-hole-shaped in that it has a narrow portion and terminates in a connected wider portion, said slot being constructed and arranged to receive the key means of the carriage in the narrow portion when the carriage is aligned with the track and moved to the terminating portion, to limit further forward movement of the carriage, and to retain the carriage when the first carriage section is tilted relative to the track, to prevent movement of the first carriage section in either direction along the track.

5. Apparatus as set forth in claim 4 wherein said key means is a portion non-circular in cross section of a non-rotatable front axle for a pair of wheels of the first carriage section.

6. In apparatus for charging a steel-making furnace: a track formed of two spaced side-by-side guides and rack means to provide a driving surface, said track and rack means extending between a first location remote from a furnace and a second location adjacent and above a furnace where the furnace is charged, said track having a terminal portion inclined downward relative to a preceding portion, an articulated carriage movable along the track between the two locations, said carriage having first and second sections and pivot means securing the first and second sections together for relative angular movement about an axis transverse to the direction of carriage movement along the track, said carriage extending between the two spaced guides and having wheels on opposite sides at front and rear ends of the carriage and also adjacent to or directly at the pivot means, all engageable with the spaced guides; a container for a furnace charge secured to the said first section of the carriage; a pivoted support on the first section of the carriage for the charge container, which permits the container to remain vertical while the carriage sections travel along the upwardly and downwardly inclined portions of the track, and stop members on the first section of the carriage that limit the pivoted movement of the charge container relative to the carriage; drive means connected to the said second section of the carriage for moving the carriage along the track, in-

cluding a toothed drive wheel engageable with said rack means; and means to stop movement of the first section of the carriage at the terminal portion of the track without stopping movement of the second section, whereby the said pivot means and the wheels at or adjacent to the pivot means are lifted from the guides as the second section of the carriage continues to move along the track, titling the said first section of the carriage and the container forward to introduce a charge to a furnace.

7. In a method of charging a steel-making furnace, the steps comprising: providing a track extending between a first location remote from a furnace and a second location adjacent and above the furnace; carrying a furnace charge along said track by supporting a charge containing vessel on a leading section of a two-section articulated carriage for limited pivoted movement relative to said leading section, and moving the carriage along the track toward said second location by applying a moving force to a trailing section of said carriage; stopping movement of the leading section of the carriage at said second location while continuing to move said trailing section toward said second

location; tilting said vessel, only after relative pivoted movement between the vessel and the leading carriage section is prevented, by forward and upward movement of the leading carriage section caused by continued movement of the trailing section toward said second location, thereby introducing a charge from the vessel to the furnace; and positively preventing movement of the leading carriage section along said track while tilting said vessel.

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