

[72] Inventor **Hartman Mitchell**
Pittsburgh, Pa.
[21] Appl. No. **868,353**
[22] Filed **Oct. 22, 1969**
[45] Patented **Dec. 21, 1971**
[73] Assignee **Koppers Company, Inc.**
Continuation-in-part of application Ser. No. 813,561, Apr. 4, 1969, now abandoned.
This application Oct. 22, 1969, Ser. No. 868,353

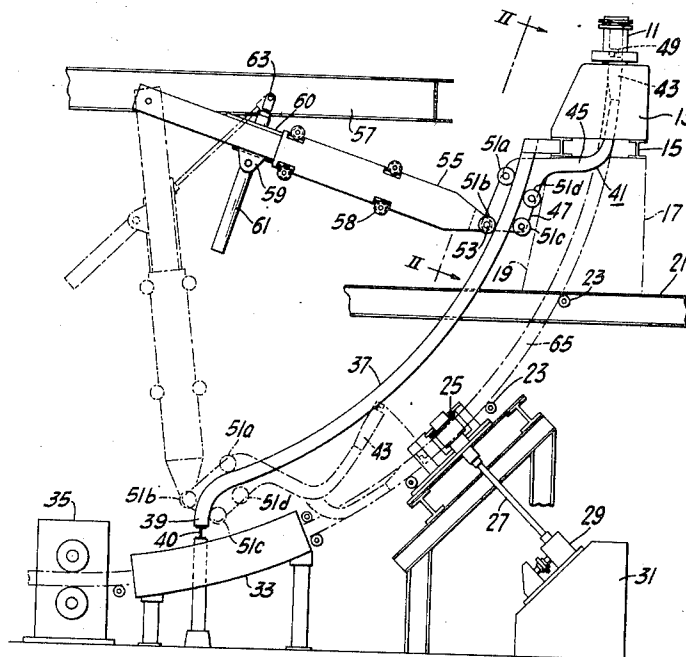
[56] References Cited
UNITED STATES PATENTS
3,209,922 10/1965 Melvin 214/1 BD
3,433,287 3/1969 Greenberger 164/274
3,528,486 9/1970 Golde 164/274
3,540,522 11/1970 McDermott et al. 164/269 X
FOREIGN PATENTS
982,981 2/1965 Great Britain 164/282

Primary Examiner—Robert D. Baldwin
Attorneys—Sherman H. Barber and Olin E. Williams

[54] **PIVOTALLY MOUNTED STARTER BAR IN A CONTINUOUS CASTING MACHINE**
14 Claims, 7 Drawing Figs.

[52] U.S. Cl. 164/274,
164/282
[51] Int. Cl. B22d 11/08
[50] Field of Search 164/274,
282, 273, 82, 269; 214/1 BD; 198/222; 226/160,
162; 105/150-153

ABSTRACT: A short starter bar is pivotally connected to a radial arm that is power operated and is movable through an angle in a plane to bring the starter bar into cooperative relation with a continuous casting mold. A combination pinch and straightener roll assembly acts on the cast strand to withdraw it from the mold and to disconnect the strand from the starter bar.



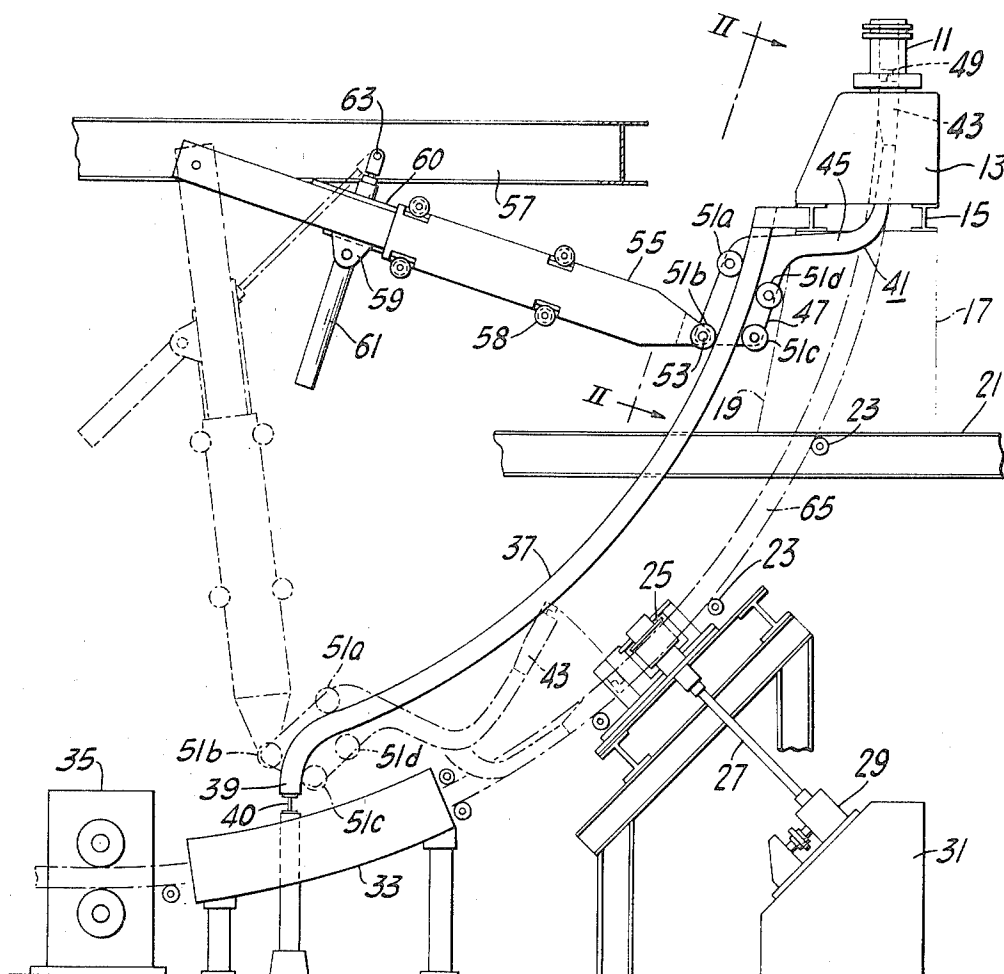


FIG. 1

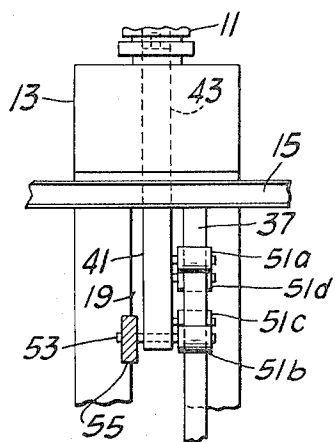


FIG. 2

INVENTOR.
HARTMAN MITCHELL

BY *Sherman H Barber*
Attorney

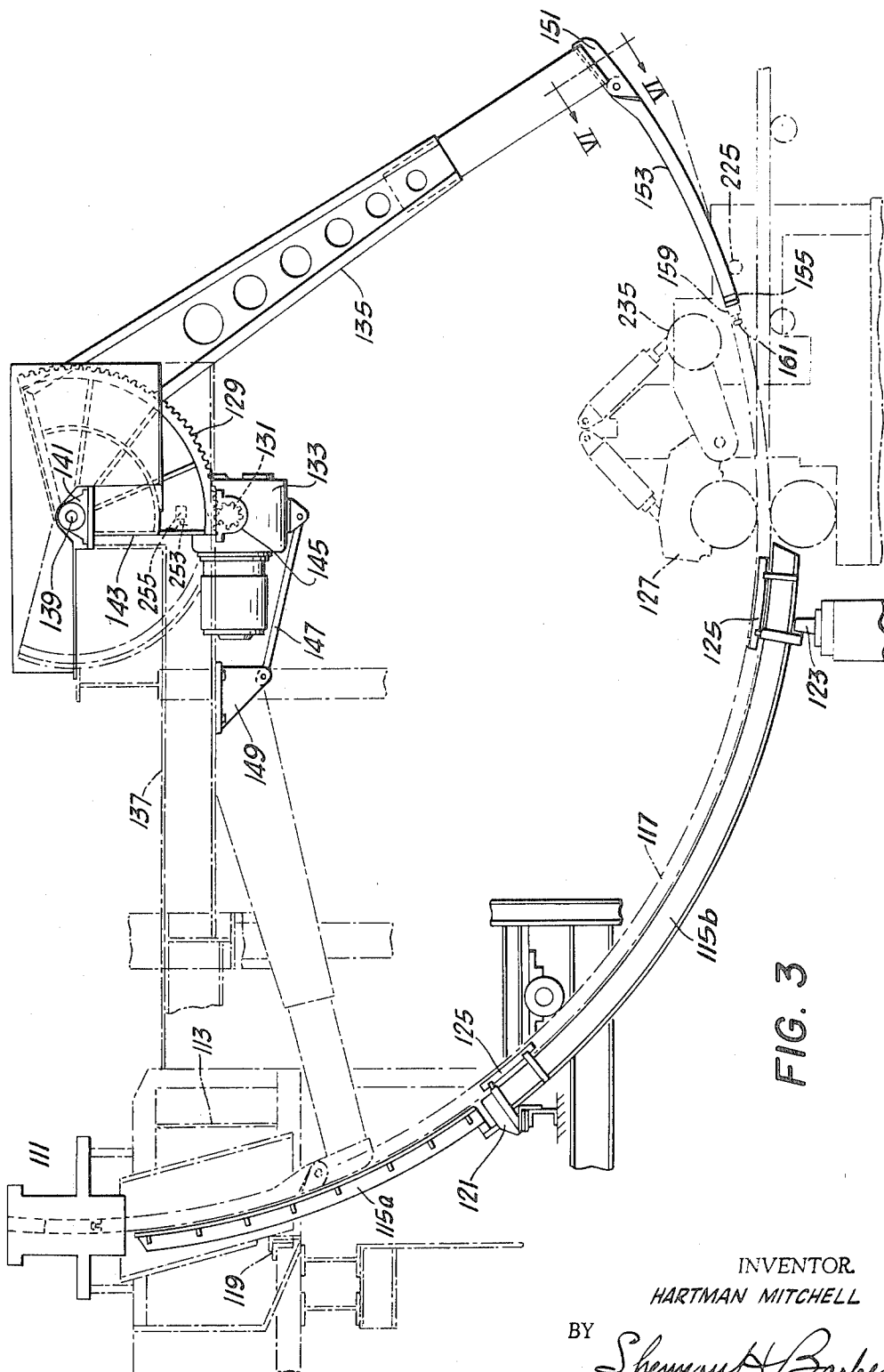


FIG. 3

INVENTOR
HARTMAN MITCHELL

BY *Sherman H. Barber*
ATTORNEY

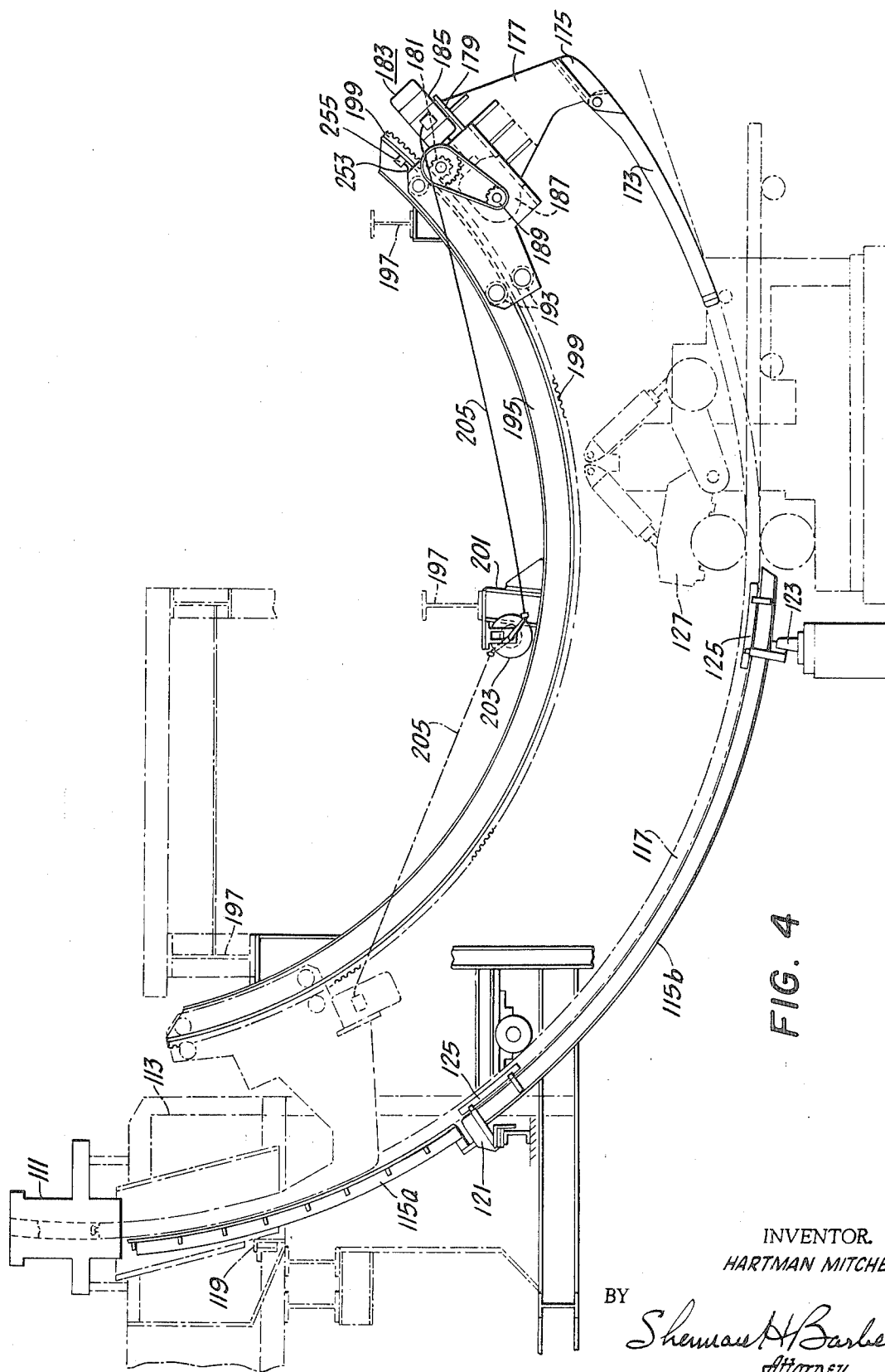


FIG. 4

INVENTOR.
HARTMAN MITCHELL

BY
Sherran H. Barber
ATTORNEY

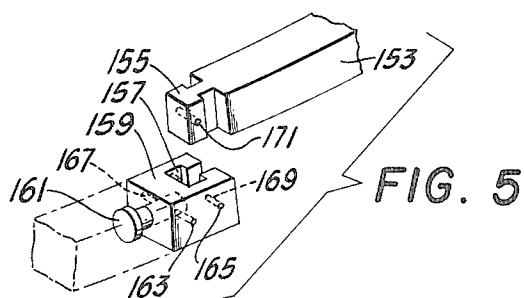


FIG. 5

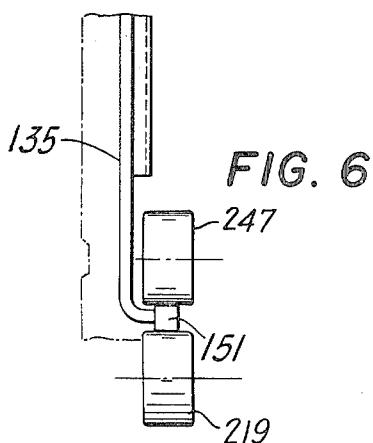


FIG. 6

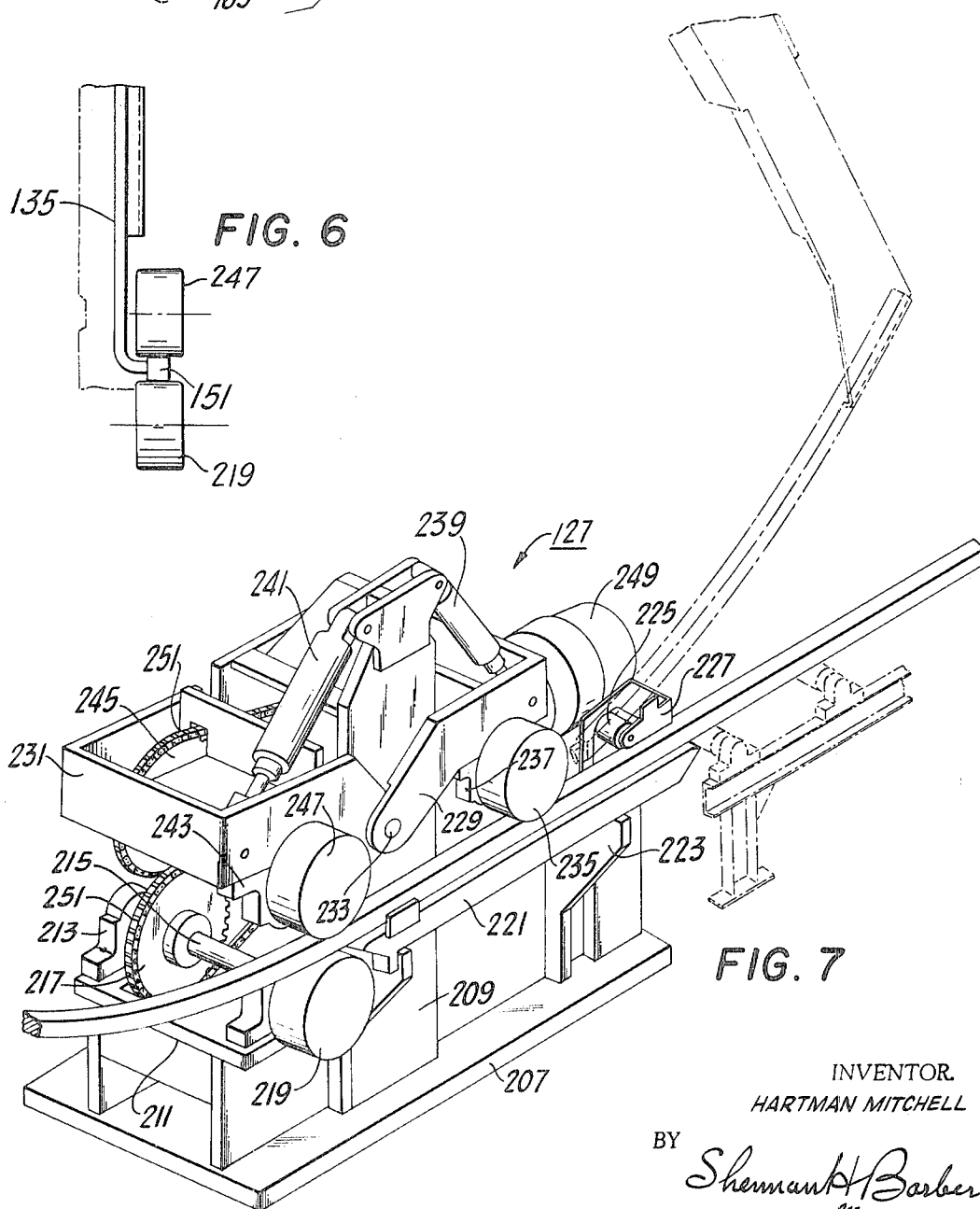


FIG. 7

INVENTOR.
HARTMAN MITCHELL

BY *Sherman H. Barber*
ATTORNEY

PIVOTALLY MOUNTED STARTER BAR IN A CONTINUOUS CASTING MACHINE

CROSS-REFERENCE TO RELATED APPLICATION

This application is a continuation in part of Application Ser. No. 813,561, filed Apr. 4, 1969 now abandoned.

BACKGROUND OF THE INVENTION

This invention relates to continuous metal casting and, more particularly, to a starter bar for withdrawing a cast strand from a continuous casting mold. The invention relates further to novel strand withdrawal and strand starter bar disconnect apparatus.

Heretofore, starter bars for closing the bottom of a continuous casting mold and for withdrawing the cast strand from the mold were either an articulated bar made up of a plurality of interconnected links, or a solid starter bar that is either curved or straight. In any case, the starter bars known heretofore had to belong enough to extend from the casting mold to the pinch rolls, or other suitable strand-withdrawal mechanism. Such bars are very cumbersome units to handle, and it has been necessary to also to provide costly guide chutes and starter accessory equipment to handle such starter bars. Further, the starter bars of the prior art required the use of considerable valuable space in the overall continuous casting machine.

The starter bar and pinch-straightener roll apparatus of the present invention, however, overcomes the known disadvantages of the prior art devices, and both are simple in design and effective in operation.

SUMMARY OF THE INVENTION

A short starter bar is pivotally mounted to a radial arm that is movable along an arcuate path to bring the starter bar into cooperative sealing relation with the bottom of the continuous casting mold. The starter bar also cooperates with a disconnect roll assembly to separate the starter bar from a continuous cast strand that is withdrawn from the mold by the starter bar.

For a further understanding of the invention and for features and advantages thereof, reference may be made to the following description taken in conjunction with the drawing which shows, for the purpose of exemplification, embodiments of the invention.

BRIEF DESCRIPTION OF THE DRAWING

In the drawings:

FIG. 1 is a schematic elevational view of a portion of a continuous casting machine incorporating a starting bar in accordance with the invention;

FIG. 2 is a sectional view along line II—II of FIG. 1;

FIG. 3 is a schematic elevational view of a portion of a continuous casting machine incorporating an embodiment of the present invention;

FIG. 4 is a schematic elevational view, similar to FIG. 3, of another embodiment of the invention;

FIG. 5 is a schematic perspective view of a detail of the apparatus of FIGS. 3 and 4;

FIG. 6 is a sectional view along line VI—VI of FIGS. 3 and 4; and

FIG. 7 is a schematic perspective view of a pinch-straightener assembly in accordance with the invention.

DETAILED DESCRIPTION

In FIG. 1, a continuous casting mold 11 is supported in a conventional manner by a mold-oscillating unit 13 that may be similar to the structure disclosed in U.S. Pat. No. 3,409,070. The mold-oscillating unit 13 is supported on fixed structural beams 15.

Below the structural beams 15, there is a spray chamber 17 that includes one-slotted side 19 for a purpose that will be described hereinafter. The spray chamber 17 is supported on a spray floor 21 in a conventional manner.

Beneath the spray floor there is a plurality of strand-supporting rollers 23 of an apron structure that are arranged on a circular arc in a usual manner.

A set of power-driven pinch rolls 25 are arranged so as to engage the strand and are located about where shown in FIG. 1. Such rollers are powered by a drive shaft 27 connected to a source of power 29 that is supported upon a fixed base 31.

Beyond the pinch roll set 25 there is a curved strand-reheating furnace 33, and just beyond that there is a first strand-reducing-roll stand 35.

The structural beams 15 extend outwardly toward the left, as viewed in FIG. 1, and support the upper end of an arcuate guide rail or bar 37. The lower end 39 of the guide rail is a cam that is curved downward rather sharply as shown in FIG. 1, and the lower cam end of the guide rail may be supported by either a suitable fixed structure such as the I-beams shown in FIG. 1, or in any other suitable manner.

An arcuate-starting bar 41 is provided with a head end portion 43, a middle body portion 45, and a lower end portion 47.

The head end portion 43 is fashioned as a hook 49, and the hook 49 cooperates with a conventional expendable member (not shown) to which the molten metal of the cast strand solidifies.

The middle body portion 45 is angularly shaped, as shown in FIG. 1, and merges with the head end 43 and with the lower end portion 47. The lower end portion 47 is generally rectangularly shaped and four rollers 51a, 51b, 51c, 51d are mounted to the lower end portion and coast with the guide rail or bar 37, and with the lower end or cam 39. Of course, other suitable members may be attached to the lower end that cooperate with the guide rail and cam in the manner described hereinafter.

The rolls 51a, 51b, 51c, 51d are journaled in cantilever fashion (FIG. 2) to the low end portion 47, and the shaft 53 that supports roller 51b also pivotally supports one end of a two-part telescopic arm 55. The inner portion of the two-part telescopic arm 55 is pivotally connected to a fixed adjacent supporting structure 57, while the outer arm portion is provided with a plurality of rollers 58 that coast with guide bars 60 secured to the inner arm portion. Thus, both parts of the arm 55 are maintained in alignment when the arm telescopes in the manner described hereinafter.

Arm 55 carries pivot 59 to which is pivotally mounted a piston-cylinder assembly 61. The free end of the piston portion of the assembly 61 is pivotally mounted as at 63 to the fixed adjacent structure 57, about where shown in FIG. 1.

In operation, the starting bar 41 is initially in a first position, shown in phantom in FIG. 1, at which location the starting bar remains inoperatively during most of the time required to cast strand 65.

At the start of a casting sequence, the two-part telescopic arm 55 is urged by the fluid actuated piston-cylinder assembly 61 to pivot in a counterclockwise direction, and the arm 55 carries with it the starting bar 41.

The starting bar 41 moves upwardly until the free, head-end portion 43, and the expendable member mentioned previously are inserted into the bottom of the mold 11 in the usual manner. After packing and chill rods are inserted in place, in accordance with usual practice, hot molten metal is introduced into the mold. When the molten metal reaches a proper depth in the mold, the piston-cylinder assembly is actuated again to pivot the arm 55 clockwise.

The arm 55 then withdraws the starting bar 41 and the cast strand 65 from the mold 11. The starting bar 41 and the cast strand 65 follow a path that is generally parallel to the arcuate portion of the guide rail 37. The cast strand 65 is supported by the apron rollers 23 in the usual manner.

The arm 55 withdraws the starting bar 41 and the cast strand 65 at a proper and desired casting speed, and the starting bar 41 and cast strand 65 pass through the spray chamber 17 wherein sprays of water cool the outer surface of the cast strand in the usual manner. The starting bar 41 passes through the slotted face 19 of the spray chamber and, if desired, the

slot itself may be provided with a flexible flap which will prevent spray water from escaping from the spray chamber once the starting bar 41 has moved downwardly past the spray chamber 17.

As the head end portion 43 passes through the open pinch rolls 25, the pinch rolls 25 close around the cast strand 65 and coact therewith to provide the withdrawal force needed. At the same time, the wheels 51a, 51b, 51c, 51d are approaching the downwardly curved cam portion 39. When rolls 51b and 51c reach the cam end portion 39, they exert a force moment about rolls 51a and 51d that urge the free head end portion 43 to pivot counterclockwise, and thereby the head end portion disconnects from the end of the cast strand 65. The cast strand 65 is, of course, now being removed from the mold under the influence of the pinch rolls 25.

When the starting bar 41 reaches the initial position shown in phantom in FIG. 1, it remains in such first position during the remainder of the casting period. From this initial position, the starting bar 41 is readily available and it moves upwardly, as mentioned previously, to commence a casting cycle.

After the starting bar is disconnected, the cast strand passes through the curved reheating furnace an thence on through the first strand-reduction roll stand.

As soon as the rollers of the reduction roll stand close on the cast strand, the pinch rolls are released, and the cast strand is then controlled by the speed of the strand-reduction roll stand.

FIG. 3 shows a curved continuous casting mold 111 that is oscillatable vertically in the usual manner, and beneath the curved mold 111, a spray chamber 113. Within the spray chamber 113 and extending therebelow are arcuate continuously extending cast strand guide sections 115a, and 115b on which a cast strand 117 rests after it emerges from the casting mold 111. The cast strand guide sections 115a, 115b are supported and fixed to adjacent structure at locations such as 119, 121, 123. At each of the locations 121, 123, a cast strand side guide 125 is provided to maintain the cast strand 117 on the strand guide sections 115a, 115b.

Adjacent the lower end of the cast strand guide section 115b, there is a pinch-straightener roll mechanism 127 which is shown in FIG. 7, and which is described hereinafter in greater detail.

Above the pinch-straightener roll mechanism 127 there is a gear segment 129, a pinion 131, a pinion drive mechanism 133, and a starter bar arm 135, all of which are mounted to fixed supporting structure 137.

The gear segment 129 is journaled to a shaft 139 that is mounted in bearings 141 connected to a suitable foundation 143; the foundation 143 being fixed to the supporting structure 137.

The gear segment 129 is constantly in engagement with the pinion 131 which is journaled, as at 145, to the supporting structure 137. The pinion 131 is driven by a pinion drive mechanism 133 which may be an electric motor-speed-reducer assembly, an hydraulic motor assembly speed-reducer assembly, or any other suitable powered mechanism.

The pinion drive mechanism is provided with a torque arm 147 which connects to a torque arm bracket 149 fixed to the supporting structure 137. The torque arm 147 resists turning of the pinion drive mechanism about the pinion axis when the mechanism is in operation.

The starting bar arm 135 is welded or otherwise suitably fixed to the gear segment 129 and carries at its remote outer end a shoe 151 which is substantially square in cross section (FIG. 6). To the shoe 151, there is pivotally connected an arcuate starter bar 153 which is provided with a T-headed end 155, as shown in FIG. 5.

The T-headed end 155 cooperates with a T-shaped slot 157 and a detachable head portion 159. The head portion 159 is provided with an outwardly protruding T-portion 161 that is adapted to coact with the solidified metal at the end of the cast strand 117, wherefore the starter bar 153 can withdraw the cast strand 117 from the mold 111.

The head end portion 159 has two transversely extending holes 163, 165 through it. In one of the holes 163 there is a steel-tapered pin 167 which pierces the T-portion 161 and secures it to the head portion 159. When the cast strand is cold, the tapered pin 167 may be removed and the head portion 159 may be recovered and reused. In the other hole 165, there is a soft aluminum pin 169 which extends through a matching hole 171 in the T-headed end 155. The soft aluminum pin 169, which may of course be made of any other suitable material, readily shears under conditions described hereinafter and the starter bar 153 disconnects from the head portion 159.

In the embodiment of the invention illustrated in FIG. 4, the casting mold 111, the spray chamber 113, the cast strand guide sections 115a, 115b, the guide support locations 119, 121, 123, the side guides 125, and the pinch-straightener roll assembly 127 are identical to those described previously; and further description at this time is considered unnecessary.

However, a starter bar 173 which is identical to the starter bar 153 described hereinbefore is pivotally connected to a starter bar shoe 175 that is welded, or otherwise suitably fixed to a starter bar arm 177. The starter bar arm 177 depends from a platform 179 that carries a shaft-mounted pinion 181 and a pinion-driving mechanism 183. The pinion-driving mechanism 183 includes an electric or hydraulic motor 185 that is operatively connected to a speed reducer 187, and a speed reducer output sprocket 189 is chain connected to drive a bull gear 191 fixed to the same shaft as the pinion shaft.

The platform 179 and all of its attendant equipment is in effect a trolley having sets of rollers 193 that coact with an arcuate guide rail 195 fixedly mounted to adjacent supporting structure, such as in indicated by I-beams 197 disposed about where shown in FIG. 4.

The lower arcuate surface of the guide rail carries an arcuate rack 199 which coacts with the pinion 181 so that the platform 179 or trolley and the starting arm 177 may be moved arcuately from one end to the other end of the guide rail 195.

Adjacent the midlength location of the guide rail 195 and near one of the I-beam supports 197, there is a support 201 that carries a reel 203 on which a retractable power supply cable or fluid-conducting hose 205 is wound. The power supply cable 205 delivers electric power to the electric motor 185 if such is used, or the hose 205 delivers hydraulic fluid to the hydraulic motor 185 if such is used.

FIG. 7 illustrates the pinch-straightener roll mechanism 127 which includes a structural support member 207 to which is fixed a vertical columnar member 209. At the left-hand side of the apparatus 127 of FIG. 7, there is a tabular support 211 which carries a pair of bearing 213 that support a horizontal shaft 215.

The horizontal shaft is driven by a sprocket 217 mounted thereto, and one overhanging end carries a roller 219.

Toward the right-hand side of the apparatus 127, as viewed in FIG. 7, there extends a fixed horizontally extending cast strand supporting bar 221 that is suitably supported upon the base member 207 by a vertical strut 223. Further toward the right and beyond the strut 223, there mounted a disconnect reaction roller 225 which is associated with a starter bar guide member 227. The purpose of the disconnect reaction roller 225 and the starter bar guide member 227 will become evident from a further description of the apparatus 127 in action.

The vertical columnar member 209 pivotally carries two spaced apart structures 229, 231, respectively, that are journaled to a common shaft 233.

The structure 229 carries a roller 235 that is journaled in bearings 237 mounted to the structure 229. The structure 229 is also pivotally connected to a cylinder-piston 239 which is connected to the vertical columnar member 209 about as shown in FIG. 7. Thus, the roller 235 is pivotal about the shaft 233 as a center.

Likewise, the structure 231 is also connected to a cylinder-piston assembly 241 that is connected to the vertical columnar

member 209 in the same way the cylinder-piston assembly 239 is connected, and is, therefore, pivotal above the shaft 233. The structure 231 carries a set of bearings 243 that support a horizontally extending shaft (not shown) on which is mounted a driven sprocket 245 and a roller 247. The roller 247 is substantially above and vertically aligned with the bottom or lower fixed roller 219.

An electric motor or an hydraulic motor type of power source 249 is mounted as shown at the right-hand side of the apparatus 127, and, chains 251 surrounding the sprockets 217, 245 also coast with sprockets (not shown) driven by the power apparatus 249.

Now, referring to FIG. 3 in order to understand the operation of the apparatus, it will be assumed that initially the starter bar 153 is in the position shown in solid lines at the right-hand side of FIG. 3; this being the position in which the starter bar rests after it has been disconnected from the continuous cast strand withdrawn during a previous cycle. While in the position shown, a new head portion 159 is installed on the T-head end portion 155 of the starter bar in readiness for use when the next strand is to be cast.

When the mold 111 is ready to receive the starter bar in order to close the bottom of the mold prior to the commencement of another cast, the pinion-drive mechanism 133 is actuated to rotate the gear segment and starter bar arm clockwise through an angle of about 110°. The starter bar then enters the bottom of the mold, about as shown in the phantom outline in FIG. 3, and the mold is temporarily sealed in the usual manner prior to the introduction of molten steel into the mold.

When it is determined to commence withdrawing the continuous cast strand from the mold, the pinion drive mechanism is reversed to rotate the gear segment and the starter bar arm counterclockwise. The cast strand, upon emerging from the mold, contacts and is supported by the strand guide sections. The gear segment and starter bar continue to rotate counterclockwise withdrawing the cast strand until a resilient finger 253 on the gear segment actuates a control switch 255 located on the supporting structure 137 or other comparable structure.

When the resiliently mounted finger actuates the switch 255, a solenoid fluid-control valve is actuated which results in the movement of the disconnect roller 235 downward into engagement with the cast strand. The starter bar, being supported by the reaction roller 225, does not move, but the disconnect roller 235 exerts enough force on the strand to shear the soft aluminum pin 169, wherefore the starter bar is disconnected from the head portion that remains connected to the cast strand. The cast strand then proceeds horizontally toward the right, as viewed in FIGS. 3 and 7. The starter bar then remains in the position shown by the solid outline of FIG. 3, which is the final position of rest during the remaining period of the withdrawing cycle of the cast strand.

The apparatus of FIG. 4 operates similarly to that of FIG. 3 with the exception that the trolley moves from an initial position shown in solid outline to the position shown in phantom at the left-hand side of FIG. 4. It should be noted that the reel 203 is rotatable one way when it is necessary to extend the cable or nose 205, and is rotatable in the other direction to retract the cable or nose when the trolley passes close to the reel.

A resilient finger 253 and switch 255 are mounted on the trolley and guide rail, respectively, which switch when actuated by the finger actuates a solenoid fluid-control valve that results in the downward movement of the disconnect cylinder-piston thereby lowering the disconnect roll 235 in the manner described previously.

Of course, those skilled in the art will recognize that many other ways of driving the short continuous casting starter bar of the invention are possible; such as, pivoting an arm carrying a short starter bar with a power driven pinion mounted to the arm. The pinion cooperates with a curved rack whereby, when the pinion is actuated, the arm pivots about it and drives the short starter bar upward into cooperation with a continuous casting mold.

In like manner, a pivoted arm carrying a short starter bar may be moved by an hydraulic cylinder-piston arrangement. These are only a few of the other possible ways to drive a short starter bar.

Those skilled in the art will recognize from the foregoing description of embodiments of the invention several significant features and advantages among which are:

That the starter bar is pivoted to the shoe wherefore the starter bar can enter and cooperate easier with the bottom of the continuous casting mold; and

That the pinch-straightener roll assembly with cantilevered rolls eliminates the need for a separate set of electrical controls usually required to synchronize separate pinch rolls and separate straightener rolls.

What is claimed is:

1. In a continuous casting machine with a vertically reciprocable mold wherein molten metal partially solidifies and forms a cast strand the improvement comprising:

- a. an arm moveable along an arcuate path,
- b. a starter bar mounted to said arm;

means to move said arm from a first position to a second position at which said starter bar cooperates with and closes said mold before molten metal is introduced thereinto to initiate said cast strands;

d. means to move said arm and said starter bar from said second position toward said first position thereby withdrawing said cast strand from said mold; and

e. means to disconnect said starter bar from said cast strand before said arm reaches said first position.

2. The invention of claim 1 wherein:

a. said means includes,

- i. a segmental gear to which said arm is secured, and
- ii. means to pivot said segmental gear about an axis.

3. The invention of claim 1 wherein:

a. said means includes;

- i. a trolley to which said arm is secured, said trolley having wheels that coast with
- ii. a fixed guide rail; and
- iii. means to move said trolley on said guide rail.

4. The invention of claim 1 wherein:

a. said starter bar is pivotally mounted to said arm.

5. In a continuous casting machine including a vertically reciprocable mold wherein molten metal partially solidifies and forms a cast strand, the improvement comprising:

a. a starter bar for closing said mold initially and for withdrawing said cast strand from the mold, said bar including

i. a head end portion releasably connectable to said strand;

b. an arcuate guide rail located in spaced relation to the path traversed by said cast strand after it leaves said mold;

c. means connecting said starter bar to said guide rail for guiding said starter bar along an arcuate path defined by the said guide rail;

d. means to move said starter bar along said path and into cooperative relation with said mold, and to withdraw said bar and casting from said mold; and

e. means to disconnect said head end portion from said cast strand.

6. In a continuous casting machine including a vertically reciprocable mold wherein molten metal partially solidifies and forms a cast strand, the improvement comprising:

a. a starter bar for closing said mold initially and for withdrawing said cast strand from said mold including:

- i. a head end portion having means adapted to releasably connect said starter bar to said cast strand,
- ii. a middle body portion secured to said head end portion, and
- iii. a lower end portion secured to said middle body portion;

b. a guide rail secured in position adjacent the path traveled by said cast strand when it leaves said mold, said guide rail having a cam portion fused thereto;

- c. means connected to said lower end portion and coactive with said guide rail so that said head end portion follows a path determined by said guide rail;
 - d. means to move said head end portion from an inoperative position into cooperative relation with said mold whereby said mold is closed at the bottom and molten metal is retained therein to initiate said cast strand;
 - e. means to move said starter bar away from said mold whereby said starter bar withdraws said cast strand from said mold; and
 - f. means to bring said means mounted to said lower end portion into coactive relation with said cam portion whereby said head end portion is released from said cast strand and said starting bar is disposed in said inoperative position.
7. The invention of claim 6 wherein:
- a. said means connected to said lower end portion includes a plurality of rollers that cooperate with said guide rail.
8. The invention of claim 6 wherein:
- a. said means to move said head end portion includes:
 - i. an arm pivotally attached to said starter bar,
 - ii. a support to which said arm is pivotally attached, and
 - iii. means to pivot said arm.
9. The invention of claim 8 wherein:
- a. said arm is telescopic; and
 - b. said means to pivot the arm is a fluid actuated piston-cylinder assembly.
10. In a continuous casting machine including a vertically reciprocable mold wherein molten metal partially solidifies and forms a cast strand, the improvement comprising:
- a. a starter bar for closing said mold initially and for withdrawing said cast strand from said mold including:
 - i. a head end portion having means adapted to releasably connect a starter bar to said cast strand,
 - ii. a middle body portion secured to said head end portion, and
 - iii. a lower end portion secured to said middle body portion;
 - b. a guide rail secured in a position substantially parallel to the path traveled by said cast strand when it leaves said mold, said guide rail having a cam portion fixed thereto;
 - c. a plurality of rollers mounted to said starter bar that cooperate with said guide rail and cam to support said starter bar so that said starting bar head end portion follows the path traversed by said cast strand;
 - d. an arm pivotally attached to said starter bar and to a fixed support;
 - e. means to pivot said arm about said fixed support whereby said arm moves said starter bar from a first inoperative position into cooperative relation with said mold to close the bottom thereof;
 - f. means to pivot said arm about said fixed support whereby said arm withdraws said starter bar and said cast strand from said mold; and
 - g. means to bring said rollers into cooperative relation with said cam portion whereby said starter bar disconnects from said strand and assumes an inoperative attitude in said first position

11. The invention of claim 10 wherein:
- a. said means to pivot said arm includes a fluid actuated piston-cylinder assembly that is pivotally connected to said arm and to said fixed support.
12. In a continuous casting machine with a vertically reciprocable mold wherein molten metal partially solidifies and forms a cast strand, the improvement comprising:
- a. a gear segment pivotally mounted for movement about an axis located adjacent said mold,
 - b. a starter bar mounted to said gear segment;
 - c. a pinion coacting with said gear segment;
 - d. means for actuating said pinion for pivoting said gear segment and moving said starter bar into said mold whereby the bottom thereof is closed and molten metal is retained therein to initiate said cast strand, and
 - e. apparatus for withdrawing said cast strand from said mold and for disconnecting said starter bar from said cast strand.
13. The invention of claim 12 wherein:
- a. said apparatus for withdrawing said cast strand from said mold and for disconnecting said starter bar from said cast strand comprising:
 - i. a frame,
 - ii. a first power-driven roller cantilever mounted and fixed to said frame,
 - iii. a second power-driven roller cantilever mounted to a first unit pivoted to said frame above said first roller,
 - iv. means to pivot an locate said second roller in spaced relation to said first roller whereby said first and second rollers coact with said cast strand,
 - v. means to drive said first and second rollers whereby said cast strand is withdrawn from said mold,
 - vi. a third roller fixed and cantilever mounted to said frame and disposed in spaced relation to said first and second rollers,
 - vii. a fourth roller cantilever mounted to a second unit pivoted to said frame and disposed between said third and said first rollers,
 - viii. means to pivot said fourth roller into engagement with said cast strand whereby said cast strand is disconnected from said starter bar which reacts with said third roller.
14. In a continuous casting machine with a vertically reciprocable mold wherein molten metal partially solidifies and forms a cast strand, the combination therewith comprising:
- a. an arm movable along an arcuate path,
 - b. a starter bar mounted to said arm
 - c. means to move said arm from a first position to a second position at which said starter bar cooperates with and closes said mold before molten metal is introduced thereinto to initiate said cast strand; and
 - d. means to withdraw said starter bar and said cast strand from said mold, and
 - i. a first pair of powered rollers one of which is pivotally mounted to a frame and the other of which is fixed to the frame, and with
 - ii. a movable second roller that acts upon said cast strand to disconnect it from said starter bar.

* * * * *

60

65

70

75

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,628,595 Dated December 21, 1971

Inventor(s) Hartman Mitchell

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Claim 1, line 21, before "means", insert --- c) ---

line 24, change "strands", to --- strand ---

Claim 6, line 75, change "fused", to --- fixed ---

Claim 10, line 40, change "he", to --- the ---

Claim 13, line 28, change "an", to --- and ---

Claim 14, line 44, change "an", to --- and ---

Signed and sealed this 24th day of April 1973.

(SEAL)

Attest:

EDWARD M. FLETCHER, JR.
Attesting Officer

ROBERT GOTTSCHALK
Commissioner of Patents