CONTINUOUS CASTING MACHINE
STARTING SYSTEM

Inventors: Joseph Rokop; Geoffrey W. Hughes, both of Bethel Park, Pa.

Assignee: Pennsylvania Engineering Corporation

Filed: Sept. 2, 1970

Appl. No.: 69,045

U.S. Cl. 164/274, 164/282

Int. Cl. B22d 11/08

Field of Search 164/82, 274, 282, 283

References Cited

UNITED STATES PATENTS

3,324,934 6/1967 Hess et al. 164/274
3,446,270 5/1969 Michelson 164/274 X
3,495,651 2/1970 Rokop et al. 164/283 X
3,277,538 10/1966 Bryce 164/270 X
3,351,124 11/1967 Hess 164/274
3,344,844 10/1967 Reinfeld et al. 164/274

3,426,835 2/1969 Michelson 164/274

Primary Examiner—R. Spencer Annear
Attorney—Wiviott & Hohenfeldt

ABSTRACT

An articulated starting bar is adapted for being driven from a high elevation storage position to a position where its head end closes the bottom of an elevated mold. A solidifying billet or strand is attached to and is withdrawn with the head end as the starting bar is withdrawn. After passing through a straightener roller mechanism, the head is detached and follows a horizontal path with the strand, but the starting bar is diverted in a vertically upward path for storage clear of the adverse conditions which prevail at the lower level. Power actuated means are provided for initiating advancing and retracting the starting bar to and from the straightener mechanism. Means are provided for positively latching the bar in its home position of storage.

4 Claims, 10 Drawing Figures
CONTINUOUS CASTING MACHINE STARTING SYSTEM

BACKGROUND OF THE INVENTION

In machines for casting a continuous metal billet or strand there is a flow-through mold with a bottom outlet. Metal is poured from a ladle into a tundish which admits molten metal to the mold at a controlled rate. Before starting the strand it is necessary to close the bottom of the mold temporarily so that the initial charge of molten metal will not just run through the mold. When the outside of the strand is cooled enough to form a sufficiently strong skin to preserve the shape of the strand, the means which are used to close the bottom outlet may be removed and the strand is thereafter formed and withdrawn at a substantially constant rate.

In one type of casting machine, the strand enters vertically through the upper end of a curved roller apron which changes the direction of the strand to horizontal and directs it to a straightener mechanism.

Initially, the starting bar is advanced reversely through the roller apron until its head end registers in the bottom outlet of the mold. The starting bar is then withdrawn from the roller apron and the partially solidified strand follows. After the head end of the starting bar has passed through the straightener mechanism, the bar is separated from the strand and directed to a storage position while the strand continues in another path.

Starting bars constituting both rigid curved members and chain-like or articulated members have been used in the past. The rigid curved type of bar is stored, after casting is initiated, in a curved storage chamber that is comparable in configuration and size to the roller apron which guides the strand down to the straightener mechanism. Because of the size of the storage mechanism, it is difficult to find space to accommodate it without sacrificing other design objectives.

The method of handling and storing the articulated type of starting bar has been to withdraw it through the straightener mechanism and divert it downwardly below the horizontal pass line of the strand as it exits from the straightener rolls. This means that the starting bar is stored below the conveyor on which the continuous strand is cut into suitable lengths in which case the starting bar often becomes badly fouled with various kinds of refuse including slag that is produced by the cutting torches which are used to cut the strand.

SUMMARY OF THE INVENTION

An object of the present invention is to overcome the above-mentioned problems by providing an articulated starting bar which may be stored in a convenient manner above the pass line of the strand and clear of the region where the starting bar would be subject to fouling or would interfere with arrangement of other components of the machine.

Another object of this invention is to provide novel actuator and latching means for initiating the advancement of the starting bar toward the mold and for finally retracting the same to its home or storage position. An adjunct to this object is the provision of means for positively engaging the mold remote end of the starting bar with the actuator and for positively securing the bar in its stored position.

Briefly stated, the new starting system for a continuous strand casting machine comprises a starting bar storage structure which extends principally in a vertical direction above the pass line of the strand. The inlet end of the storage structure has a guide section which diverts all but the head end of the starting bar from its horizontal path through the straightener mechanism to its vertical path in the storage structure. The guide section is so designed that the head end of the starting bar is caused to remain with the leading end of the strand in which case the head end may be retrieved and reconditioned for the reuse on the next occasion of starting.

How the aforementioned objects and other more specific objects are achieved will appear from time to time throughout the course of the ensuing description of an illustrative embodiment of the invention taken in conjunction with the drawings.

DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side elevational view of a continuous casting machine embodying the invention;
FIG. 2 is a side elevational view showing more details of the starting bar storage and actuating system, the strand straightener and the withdrawal mechanism, the latter being shown in phantom lines;
FIG. 3 is a side elevation sectional view of a part of the guide section which diverts the starting bar in one direction and allows the head member and strand to follow a pass line in another direction;
FIG. 4 is a view of the strand exiting side of the guide section;
FIG. 5 shows the head end of the starting bar partially in section;
FIG. 6 is a sectional view taken on a line corresponding with 6—6 in FIG. 5;
FIG. 7 is a side elevational view of the starting bar advancement initiating and retracting actuator with parts removed, and of the remote end of the starting bar and its latching mechanism;
FIG. 8 shows a section of one of the hinge joints of the articulated starting bar taken on the line 8—8 in FIG. 2;
FIG. 9 is a cross section of a joint in the starting bar head taken on a line corresponding with 9—9 in FIG. 5; and
FIG. 10 is a vertical cross section of the starting bar and latch arm taken on the line corresponding with 10—10 in FIG. 7.

DESCRIPTION OF A PREFERRED EMBODIMENT

FIG. 1 illustrates some components of a continuous billet or strand casting machine. Most of the structural steel members which support the illustrated components have been omitted from the drawing for the sake of brevity.

The casting machine comprises a ladle car 10 which is supported on tracks 11 so that it may traverse over several casting machines operated in parallel. A ladle 12 which has a bottom gate valve, not shown, is used to transfer molten metal to the casting machine by way of a tundish 15. The ladle is shown supported on car 10.

A tundish 15 is located below the ladle for receiving molten metal out of the bottom of ladle 12 under control of the operator. The tundish 15 admits molten metal into a flow-through mold 17. Mold 17 is sur-
rounded by a water cooling chamber which effects solidification of the outer skin of the strand that is formed in the mold so that it will maintain its shape as it emerges from the mold.

The mold 17 is supported on an oscillating mechanism which is marked 18. The drive means for the oscillating mechanism have been omitted. This mechanism moves the mold up and down at controlled rates in a vibratory action so as to free the strand from the interior of the mold 17.

As the hot metal strand emerges from the mold 17 it is admitted to the vertically oriented entrance end 19 of a curved roller apron which is generally designated by the numeral 20. The roller apron may be made in sections and be fastened at a number of places, one of which is exemplified by the anchor 21. The roller apron comprises a pair of tracks 22 and 23 which are spaced apart to provide a guide for the starting bar rollers as will be described later. Also in the roller apron are a series of staggered stationary rollers 24 which induce a curve in the strand 31 as it traverses down the apron to a known type of straightener and withdrawal mechanism which is generally designated by the number 25.

The construction and operation of the straightener and withdrawal mechanism 25 will now be described to the extent necessary to establish its relationship with the present invention. Referring to FIG. 1 and to FIG. 2 where the mechanism 25 is shown in phantom, it will be seen to comprise upper and lower pairs of withdrawal rollers 26, 27 and 28, 29. There is also a centrally located straightener roller 30 which co-acts with the other pairs of rollers to remove the irregularities of the hot billet or strand 31 as it passes through the straightener mechanism. The fragment 31 of the strand shown in FIG. 2 is assumed, of course, to have passed down roller apron 20 from mold 17 and is shown as having passed through the entry rollers 26 and 27 of the straightener mechanism.

Exit rollers 28 and 29 and entry rollers 26 and 27 are adapted for being driven with hydraulic motors which are symbolized in FIG. 1 and assigned the reference numerals 32, 33, 34 and 35. The hydraulic supply system for these motors is such that they may be driven as independent pairs 28, 29 and 26, 27 or they may be driven simultaneously. The motors and rollers may also be advanced and retracted vertically so as to selectively engage or disengage with strand 31 or with the starting bar which is generally designated by the reference numeral 36 in FIG. 2. The hydraulic system for operating motors 32–35 is not shown.

In FIG. 2, the starting bar 36 is shown still attached to strand 31 which has been admitted through exit rollers 26 and 27. This condition prevails only when the casting process is being initiated. During normal operation, starting bar 36 is diverted into its storage structure 37 by means of a guide section 38 which also permits the strand 31 to continue along its horizontal pass line so that the strand will run onto a cut-off table as can be seen in FIG. 1. The cut-off table 39 is equipped with a burning torch mechanism 40 which is adapted for following along with strand 31 so that it may cut the strand straight across to desired lengths. In accordance with the prior art, the starting bar was stored under cut-off table 39 in which case the bar was often adversely affected by the slag which is incidental to use of a burning torch and there were occasions when the starting bar itself was damaged by the flame of the torch.

One may see in FIG. 2 that the articulated starting bar 36 comprises a series of links 41 which are pivotally connected by shafts 42. The opposite ends of the shafts have rollers 43 which run on the inside of spaced apart tracks 44 and 45, for instance. The tracks for guiding the starting bar in storage structure 37 are similar in construction and arrangement to tracks 22 and 23 in roller apron 20. The cross sectional view of the tracks may be seen in FIG. 10. They comprise channels or angle irons each of which has a laterally extending leg 46, 47, 48 and 49. A typical pair of tracks 46 and 47 are spaced apart from each other to provide a runway for the rollers 43 which are carried on the starting bar link shafts 42. The starting bar 36 runs on these similar tracks in both the roller apron 20 and starting bar storage structure 37.

One may see in FIG. 2 that the head end 50 of starting bar 36 is separable from the principal portion of the starting bar in which case the principal portion may run up for storage into storage structure 37 and the head end 50 may continue with the strand, as is suggested by the head end being shown in broken lines, after it has been separated from the main portion of the starting bar.

The details of head 50 are shown in FIGS. 3 and 4. The head has a guide cone, not shown, which is attached only when the starting bar is being advanced toward mold 17 and is removed just before it enters in which case the head of bolt 53 closes the bottom opening of mold 17 prior to initiating withdrawal of strand 31. The guide cone is fastened temporarily to the starting bar head 52 by slipping it over a bolt 53 which has a pin 54 securing it to the head. The head 52 is pivotally connected to a link 55 by means of a pin 56. The details of this connection may be seen in the cross section shown in FIG. 9. The shaft 56 is suitably grooved at its opposite ends to receive a retainer snap ring 57 which is secured against a washer 58.

The first link 55 next to the head terminates in an open hooked portion 59 as can be seen in FIGS. 2, 3 and 5. The second link 60 which stays with the main part of the starting bar carries a transversely extending pin 61 and a stop pin 62. Considering the view in FIG. 5, it will be seen that head 50 cannot be rotated clockwise on pivot pin 61 because of interference by stop pin 62. However, it should be evident that if head 50 is rotated sufficiently counterclockwise, or if first link 55 is rotated clockwise, the first link and head may be separated from each other. In other words, pin 61 may be withdrawn from hooked portion 59 in which case the main part of the starting bar may be diverted upwardly into its storage chamber 37 as shown in FIG. 2 and the separated head 50 may continue along the horizontal pass line. Except when there is intentional separation of head 50 and link 55, their interconnection is made more secure with a spring biased detent 63. A sectional view of the separable hinged coupling is shown in FIG. 6.

Separation of the main portion of the starting bar from head member 50 as in FIG. 3, is accomplished with a guide section which is generally designated by the reference numeral 38 and is seen to connect with
starting bar storage structure 37 in FIGS. 1 and 2. A rear view of the strand exiting side of the guide section 38 may be seen in FIG. 4. Its construction will be considered in references to that figure and to FIGS. 2 and 3. The guide section comprises a pair of tracks 66 and 67 on which the guide rollers 42 of the starting bar may run. Tracks 66 and 67 in the guide section align with tracks 44 and 45 in storage structure 37. The guide section is provided with a gate 69 which is mounted on a gate pivot pin 70. Gate 69 can thereby be adjusted for effectuating proper disconnection of pin 61 in the starting bar from hook 59 in the head member 50. As can be seen in FIG. 4, guide section 38 has a pair of spaced apart side walls 71 and 72 which provide a space for the starting bar to run upwardly on tracks 66 and 67 and another space for strand 31 to continue in its horizontal path toward cut-off table 39.

Before proceeding with the detailed description of the new starting bar system, its general mode of operation will be reexamined. Assuming that the casting machine is to be put into operation, the articulated starting bar will be stored in storage structure 37. Before beginning to pour metal into mold 17, it is necessary to advance the starting bar 36 from its storage structure 37 through the straightener and withdrawal mechanism 25 and through roller apron 20 until guide cone, not shown, which is temporarily at the head end of the starting bar approaches the bottom of the mold 17. The guide cone is then removed and the starting bar is advanced until the head of bolt 53 plugs the mold. Initially, the head end 50 of the starting bar is advanced from the storage structure to a position between exit rollers 28 and 29 of the straightener and withdrawal mechanism 25. This initial movement is effected with a power actuator at the remote upper end of the starting bar. The actuator will be described in detail later. For present purposes it is sufficient to realize that the actuator is adapted to advance the starting bar a short distance from its home position and then separate from it so that the bar may be advanced by driving exit rollers 28 and 29 of withdrawal and straightener mechanism 25. The head 50 of the starting bar is engaged by the strand exit rollers 28 and 29 by lowering the upper exit roller 28 to effect a frictional drive with the starting bar. Hydraulic motor 34 is then driven and the rollers advance the starting bar until the remote end of the starting bar is uncoupled from the actuator. The hydraulic motors 34 and 35 are then operated to further advance the starting bar until its head 50 is between entry rollers 26 and 27 whereupon the latter are closed and hydraulic motors 32 and 33 are energized to continue advancing the starting bar up roller apron 20 until the head of bolt 53 at the head end of the starting bar registers in the bottom of mold 17 and closes its opening.

When the initial charge of metal in mold 17 has cooled sufficiently to form a skin that will maintain its shape, the starting bar is withdrawn from apron 20 by applying reverse power to hydraulic motors 32–35 to thereby drive entry rolls 26 and 27 and exit toils 28 and 29 reversely in which case the starting bar will be withdrawn down roller apron 20. Under these circumstances, of course, the starting bar follows its tracks and goes back to storage position inside of storage structure 37. The starting bar is retracted under the driving influence of the straightener and withdrawal mechanism 25 until the remote end of the bar is recoupled with the power actuator located above. At essentially this moment, pin 61 at the end of the starting bar separates from hooked element 59 on head member 50 and the strand 31 which is being withdrawn continues, with the head member attached, onto the cut-off table 39. Thus, it is seen that the starting bar is diverted upwardly from the horizontal path that is followed by the strand.

Referring again to FIG. 1, one may see that there is a hydraulic cylinder 75 at the top end of the starting bar storage structure 37. This cylinder is part of the actuator for initiating advancement of the starting bar and for retracting the same to its home position after it is separated from the strand. A part of cylinder 75's visible in FIG. 2 which shows that the cylinder has extending from it a piston or ram 76 which is shown in its extended position because the starting bar head 50 is correspondingly shown as being advanced into straightener mechanism 25. Ram 76 has a clevis 77 at its end as can be seen best in FIG. 7. The ram 76 and clevis 77 extend between the tracks on which the starting bar rollers 43 run. The clevis is pinned at 78 to a guide clamp 79 which has a depending tongue 80. The guide clamp is provided with rollers which run on the tracks 44 and 45 which in respect to FIGS. 2 and 7 will be called the upper tracks for present purposes. Connected with guide clamp 79 are the last links 81 and 82 in the series of links which comprise the starting bar. Link 81 is held coupled with guide clamp 79 by means of a latch arm 83 that is pivotally connected at 84 with tongue 80 which extends downwardly from the guide clamp 79. Latch arm 83 has two upwardly extending spaced apart legs 85 and 86 as can be seen in FIGS. 7 and 10. Legs 85 and 86 each have horizontal extensions or tips such as the one bearing the numeral 87, for engaging a shoulder 88 on link 81. The latch arm 83 also carries a pair of rollers 90 and 91 which are journalled on a transverse shaft 92 as can be seen in FIGS. 7 and 10.

The latch arm 83 has two states in one of which the power actuator is engaged with the starting bar as shown in solid lines and the other of which the starting bar is disengaged from the actuator as shown in broken lines. In FIG. 7 the latch arm 83 is shown in its engaged state in which case rollers 88 and 89, rollers 90 and 91 rest on a pair of lower track members 94 and 95 as can be seen in FIGS. 7 and 10. The lower track members have a part 96 which is inclined and connects with the horizontal lower track extension 97.

In the line with the straight portion 94 of the lower track, there is a pivotal switch plate 98. The switch plate 98 is in one sense an extension of tracks 94 and 95. The switch plate 98 is biased downwardly by a spring 99 which connects to a guide pin 100 that extends into a slot 101. There is also a fixed upper track extension marked 102. It will be evident that when the hydraulic actuator causes clevis 78 to execute rectilinear movement in FIG. 7, rollers 90 and latch arm 83 will follow along the top of switch plate 98 and its extension 102 until the roller 90 drops off of the end of extension 102 in which case latch arm 83 may become disengaged from link 81 and the link together with the series of links to which it is attached are freed to advance through the storage structure.
At this time it is assumed that the starting bar head end 50 has been attached to starting bar 36 as shown in solid lines in FIG. 2. When the starting bar is advanced for a short distance as described in the preceding paragraph, exit roller 28 is lowered and its hydraulic driving motor 34 is turned on together with the other hydraulic driving motor for cooperating exit roller 29. This permits advancement of the starting bar 36 and its head end 50 to the space between entry rollers 26 and 27. When head end 50 arrives in this position between consecutive set of rollers, their hydraulic motors 32 and 33 are turned on to advance the starting bar as a whole and the head end of the starting chain into registry with the bottom of mold 17.

When it is desired to start withdrawing strand 31 from the mold 17, the hydraulic motors 32, 33 and 34 are reversed in which case the major portion of starting bar 36 is driven upwardly into its storage structure 37. Ultimately, as will appear from inspection of FIG. 7, the last link 81 of the starting bar will abut guide clamp 79 which will still be extended by means of the hydraulic actuator ram 76. The driving force applied to the starting bar 36 by the hydraulic motors in the straightener mechanism 25 causes the guide clamp to start moving back toward its home position. As guide clamp 79 begins to move, it carries along with it latch arm 83 whose rollers 90 are now bearing on lower track extension 97 as shown in phantom lines in FIG. 7. Legs 85 of latch arm 83 are, of course, in a position not to interfere with rectilinear movement of link 81 of the starting bar. As guide clamp 79 moves further, rollers 90 and 91 on latch arm 83 will start riding up incline 96 of the lower tracks until the rollers strike the bottom of switch plate 98. Upon this event, the switch plate will swing upwardly in opposition to the force imposed by spring 99 and it will allow rollers 90 to pass up to where they are again on the horizontal portions 94 and 95 of the lower track. This restores latch arm 83 to its solid line position in FIG. 7 and effects the engagement of its upstanding legs 85 and 86 and the tips 87 and shoulder 88 on link 81.

FIG. 7 shows a limit switch 103 having the usual rocker arm 104 which has the rollers such as 105 at its ends. There is also another limit switch 106 which has an arm 107 and rollers 108 at its ends. Extending from guide clamp 79 is a limit switch operating cam 109 which will rock the arms 104 and 107 to alternate angular positions as the cam is advanced rectilinearly by the actuator. These limit switches and others which are not shown are for assuring a proper sequence of operation and coordination between the various active elements involved in advancing and retracting the starting bar. The two limit switches perform the functions, for example, of dictating when the exit rollers in the straightener mechanism are to be opened and closed when advancing the starting bar toward the mold and they dictate the time when the straightener mechanism can drive the starting bar after it is unlatched from the hydraulic actuator. Upon return of the starting bar to hold position, they also dictate when power is to be applied to the actuator for final retraction of the starting bar to thereby disconnect the head from the strand which is following down from the mold. These limit switches control hydraulic functions by means of electrically operated valves which are not shown and will not be described in greater detail since they can be devised and arranged by those who are skilled in electrohydraulic systems design.

In summary, a new starter bar system has been described. The system is characterized by use of an articulated bar or chain which is stored out of and above the path of the strand which is being molded. The starting bar is guided to connect with a head prior to its advancement toward the mold. The head is automatically disconnected from the major portion of the starting bar as it goes into storage at which time the head continues with the strand to a place where it may be disconnected. The starting bar is stored where it does not interfere with other functions of the machine and where it is not subjected to contamination or damage.

Although a preferred embodiment of the invention has been described in considerable detail such description is to be considered illustrative rather than limiting, for the invention may be variously embodied and is to be limited only by the interpretation of the claims which follow.

We claim:
1. A starting system for a continuous strand casting machine that has a strand guide path extending substantially from adjacent a flow-through mold to a substantially horizontally oriented strand exit end, said starting system comprising:
   a. a flexible starting bar means having head and remote ends,
   b. reversible drive means selectively engageable with the starting bar means to advance it and its head end to registry with a flow-through mold and to retract it into its storage position out of the path followed by an exiting mold strand,
   c. starting bar guide means near said reversible drive means and having a strand exiting path and a starting bar path, said guide means being adapted to direct the starting bar means into a path for being advanced toward a mold and to divert the bar means out of and in a generally vertical direction above the strand exit path during retraction of said bar means,
   d. actuator means for translating said starting bar means bidirectionally for a limited distance independently of said drive means, said actuator means being a substantial distance above said strand exiting path and proximate to said remote end of said starting bar means when the bar means is near final storage position,
   e. coupling means adapted to selectively couple and uncouple said actuator means and said starting bar means,
   f. coupling operating means disposed in proximity with said coupling means, said operating means being adapted to uncouple said starting bar means after the bar means is advanced a predetermined distance toward a mold by said actuator means and to recouple said starting bar means when the bar means retracted a predetermined distance by said reversible drive means, said actuator means being adapted to translate said starting bar means to its final storage position when the bar means is recoupled.
2. A starting system for a continuous strand casting machine that has a strand guide path extending sub-
stantially from adjacent a flow-through mold to a substantially horizontally oriented strand exit end, said starting system comprising:

a. a flexible starting bar means having head and remote ends,
b. reversible drive means selectively engageable with the starting bar means to advance it and its head end to registry with a flow-through mold and to retract it into its storage position out of the path followed by an exiting molded strand,
c. starting bar guide means near said reversible drive means and having a strand exiting path and a starting bar path, said guide means being adapted to direct the starting bar means into a path for being advanced toward a mold and to divert the bar means out of and in a generally vertical direction above the strand exit path during retraction of said bar means,
d. a powered actuator means having a rectilinearly actuable element which is adapted to be driven bidirectionally in parallelism with the path of the starting bar at an elevation remote from said strand path,
e. a latch arm means pivotally connected with said actuable element,
f. latch arm engageable means on said starting bar near its remote end,
g. first track means adapted to guide said latch arm means in one direction a predetermined distance under the influence of said actuable element whereupon the arm means may pivot out of the path of said arm engageable means and effect release of said starting bar means for advancement by said drive means, and
h. a second track means adapted to guide said latch arm means into reengagement with said engageable means when the latch arm means is moved under influence of the starting bar means when it is retracting.

3. The invention set forth in claim 4 wherein:
a. said pivotal latch arm means has rollers extending laterally therefrom, said rollers being spaced for running on said first and second track means,
b. said first track means having a pivotal support and

c. said latch means and rollers urging said first track means to pivot in opposition to said bias when the latch arm is influenced by said remote end of the retracting starting bar, whereby pivoting of said first track means enables the rollers to return from the second track means to the first track means.

4. A starting system for a continuous strand casting machine that is equipped with a flow-through mold and has a guide path extending from the mold to a horizontally oriented strand exit, said system including:

a. a flexible starting bar means comprising pivotally connected links in series,
b. head means detachably engaged with one end of the series of links, said flexible starting bar means being advanceable and retractable between positions where the head means engages with a mold and alternately where the starting bar means is out of the strand exit path and in storage position,
c. storage track means on which the starting bar means runs principally vertically upwardly with respect to the strand exit path, and

d. driving means for alternately advancing and retracting said flexible starting bar means over a major portion of its travel between mold engaging position and storage position,
e. actuator means located remotely from and above the strand exiting path,
f. automatic coupling means having two states in one of which said starting bar means is engaged with said actuator means and in the other of which said starting bar means is disengaged from the actuator means, the said actuator means further retracting said starting bar means a minor portion of its travel after it has completed the major portion of its travel and coupling means is in its engaged state, the said driving means advancing said starter bar means after said coupling means has transferred to its disengaged state,
g. a guide means confluent with said storage track means and adapted to direct said starting bar means up the storage track means and to disconnect said head means so it may continue along the strand path.

* * * * *