

United States Patent

[11] 3,583,554

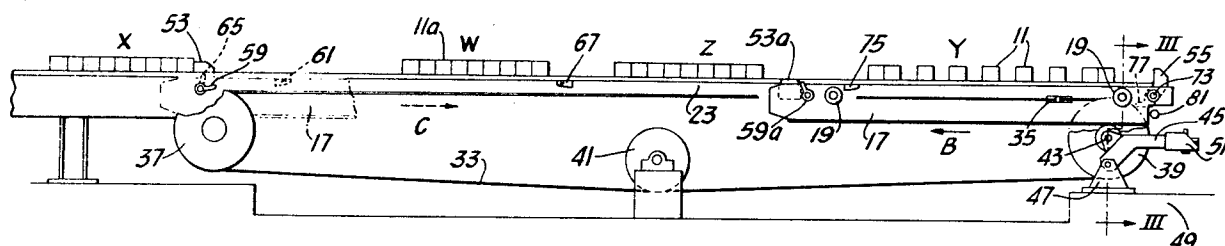
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[45] Patented **June 8, 1971**
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[54] MATERIAL TRANSFER APPARATUS 9 Claims, 6 Drawing Figs.

[52] U.S. Cl..... **198/221,**
198/34, 198/106
[51] Int. Cl..... **B65g 21/12,**
B65g 37/00, B65g 47/26
[50] Field of Search..... 198/34,
221, 222, 106

ABSTRACT: Apparatus for transferring material such as hot billets or slabs cut from a continuous casting machine comprises a carriage having pivotable dogs that engage a plurality of lengths of the billets or slabs and move them laterally as the carriage advances. The carriage then retracts and the dogs pivot to inoperative positions. When the carriage is ready to advance again the dogs pivot into operative positions.



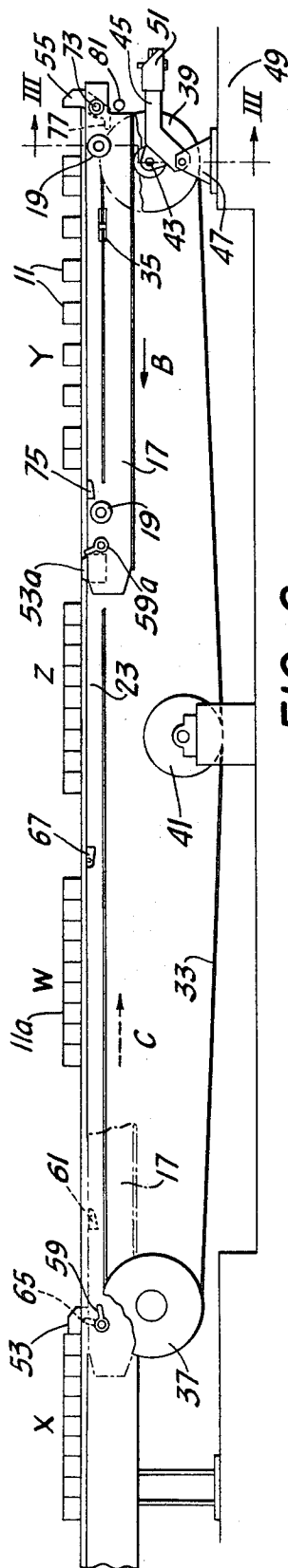


FIG. 2

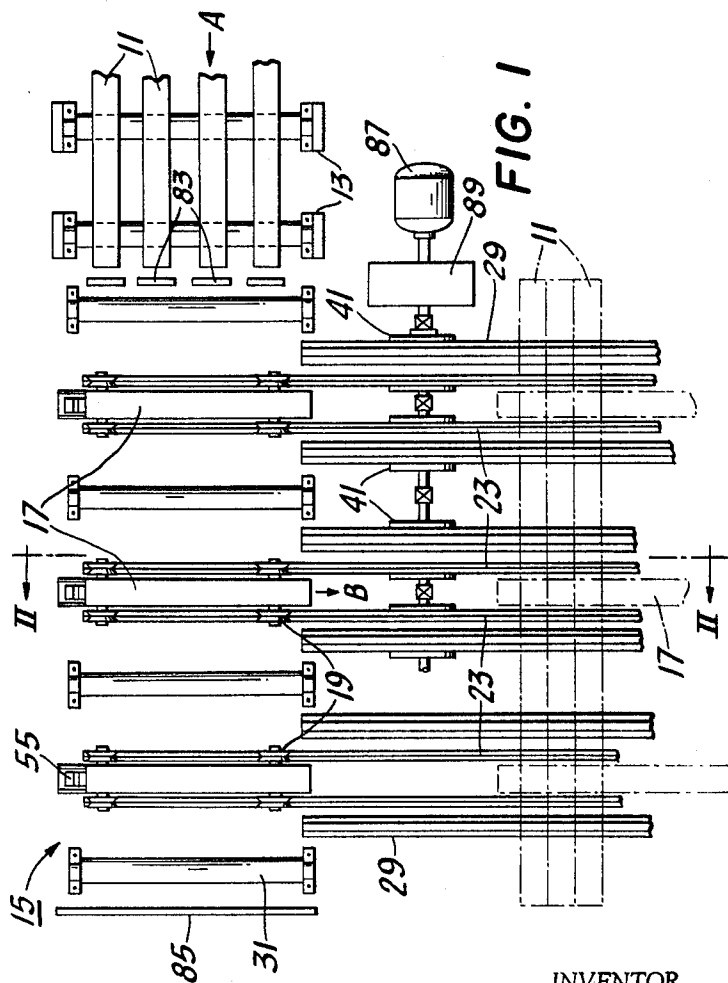


FIG. 1

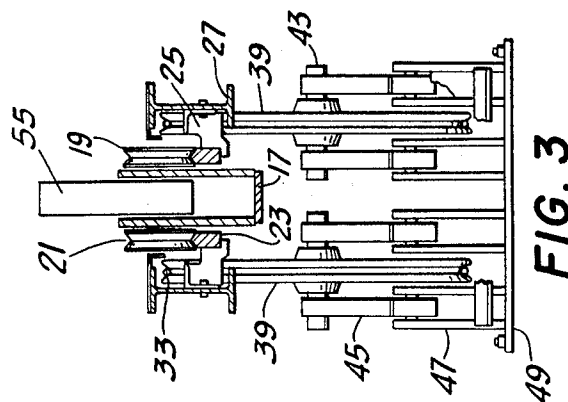


FIG. 3

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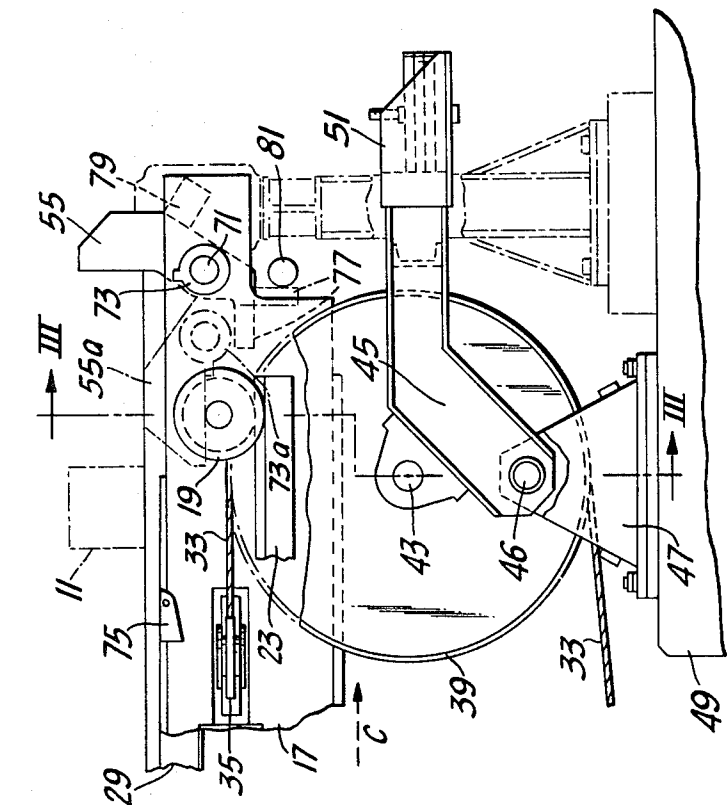


FIG. 4

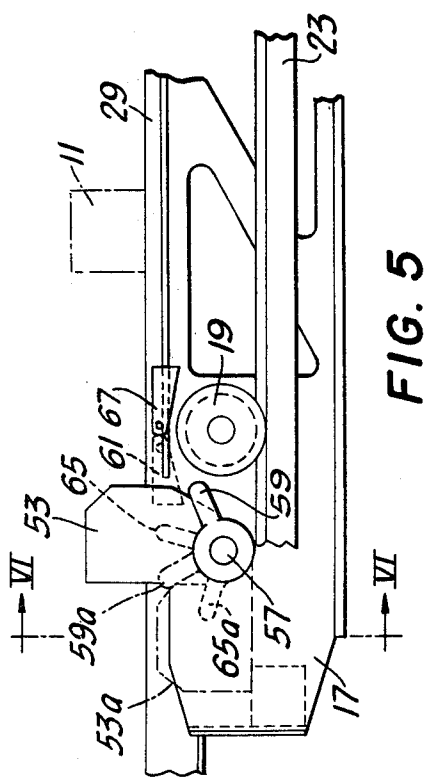


FIG. 5

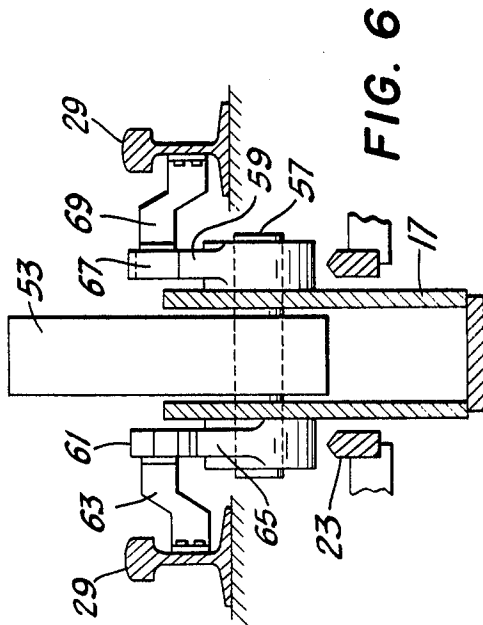


FIG. 6

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MATERIAL TRANSFER APPARATUS

BACKGROUND OF THE INVENTION

In continuous casting machines that discharge billets or slabs horizontally, the continuous cast strand or slab passes a cutoff mechanism and is severed into billets or slabs of convenient length. There is a continuing problem of collecting and stacking such lengths of billets or slabs after they leave the cutoff station, and this problem is aggravated as the rate of casting increases.

Heretofore, in some types of continuous casting machines, each billet or slab runout table has been made a finite length, and the lengths of the billet paths vary incrementally to allow the easy transfer of all billets to adjacent stacking equipment. Such an arrangement of runout tables requires considerable ground or floor area and is generally a very costly facility to install.

The equipment of the present invention requires a minimum of floor area and is effective in moving a plurality of cast billets or slab units to a cooling and stacking area in an efficient and economical manner. It is important for processing reasons, such as cooling, that the cooling bed hold the greatest number of pieces possible so that any given piece has the longest cooling retention time on the cooling bed before it is removed for further handling or processing. It is equally important that the pieces be moved onto the cooling bed in groups of such a number and weight that will not cause the pieces to "buckle" or "scramble" while being pushed from one end or side of the group.

How the equipment and method of the invention effectively accomplishes the foregoing purpose is more completely set forth in the following description of an embodiment of the invention which is exemplified in the accompanying drawings.

SUMMARY OF THE INVENTION

Billets or slabs cut from continuous cast strands are transferred along skid rails by a carriage having both front and rear pivotable dogs. The dogs are actuated by means engageable with pivotal cams so that when the carriage advances the front and rear dogs push billets along the skid rails or rolls. When the carriage retracts, the dogs pivot to inoperative positions, but as the carriage approaches the initial position the rear dog pivots to its operative position, and the front dog pivots to its operative position as the carriage advances again.

BRIEF DESCRIPTION OF THE DRAWING

An embodiment of the invention is illustrated in the drawing wherein:

FIG. 1 is a schematic plan view of apparatus in accordance with the invention;

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

FIG. 3 is a sectional view along line III-III of FIGS. 2 and 4;

FIG. 4 is an elevational view of the right-hand end of the apparatus of FIG. 2 at a slightly larger scale;

FIG. 5 is a detail of a portion of the apparatus of FIG. 2; and

FIG. 6 is a sectional view along line VI-VI of FIG. 5.

DETAILED DESCRIPTION

In FIG. 1, a plurality of lengths of cut billets 11 are shown at the right-hand end of the figure and these cut billets are moving on a runout table 13; that is, they are advancing from right to left in the direction of the arrow A toward apparatus 15 in accordance with the invention. It is to be understood that while the word "billets" is used in the following description the term is not exclusive and those skilled in the art will understand that the billets 11 may also include slabs and other shapes as well.

The apparatus 15 includes a plurality of carriages 17 that are each movable in a direction transverse to the direction of arrow A; that is, in the direction of arrow B.

Each carriage 17 is an elongate frame that is provided with pairs of opposed rollers 19 at the ends; the rollers 19 having V-grooved peripheral contours 21 that cooperate with fixed elongate rails 23 mounted in spaced apart parallel relation. The rails 23, as shown in FIG. 3, are supported by brackets 25 projecting outwardly from a structural frame 27 comprised of I-beams that support skid rails 29 on which the billets or slabs 11 rest.

Intermediate the carriages 17 (FIG. 1) there is a powered roller 31 and these rollers, driven in a known manner, continue the movement of the billets 11 in the direction of the arrow A.

A cable 33 is secured as at 35 to each side of each carriage 17, and the cables 33 pass around a pair of spaced apart fixed sheaves 37 located at the left-hand side of FIG. 2, and around a pair of spaced apart take-up, pivotable sheaves 39 located at the right-hand end of FIG. 2. Both ends of the cable 33 are anchored to a powered drum 41 located conveniently between the sheaves 37, 39. The cable 33 is so wound on the powered drum 41 that, when the drum rotates counterclockwise, the carriage 17 moves from right to left, and when the drum 41 rotates clockwise, the carriage 17 moves from left to right, as viewed in FIG. 2.

The sheaves 39 are each rotatably mounted on shafts 43 journaled in a pair of arms 45 that are eccentrically mounted by a pin 46 secured to a pivot 47. The pivots 47 are fixed to a suitable foundation or other support 49. The outer extremity of the pair of arms 45 support a counterweight 51 which pivots the arms 45 and the sheave 39 clockwise about the fixed pivot 46, to take up slack in the cables 33 thereby maintaining these cables taut. The carriage 17 has a front pivotable dog 53 and a rear pivotable dog 55; the front and rear locations being respectively the left and right-hand ends of the carriage 17, as viewed in FIG. 2.

As viewed in FIG. 5, the front pivotable dog 53 is shown in solid outline in the up or working position, and in the down or the pass position 53a by the dash-dot outline. The front pivotable dog 53 is key mounted, or otherwise suitably mounted, so as to rotate with a shaft 57 that is journaled in the carriage 17.

On the near end of the outwardly extending shaft 57, as viewed in FIG. 5, or on the right-hand end as viewed in FIG. 6, a lug 59 is fixed, as by a key or in any other suitable manner, so that the lug 59 and the shaft 57 rotate simultaneously. The lug 59 has a finger that operatively coacts with a cam 67 that is pivotally supported by a bracket 69 to some adjacent immovable structure, such as the skid rails 29. In FIG. 5, the lug 59 is shown in two positions 59 and 59a.

In FIG. 5, the cams 61 and 67 are shown adjacent, but this is for simplification purposes. Actually the cams 61 and 67, in their true relative positions, are shown in FIG. 2. That is, cam 61 is separated lengthwise from cam 67 a distance equal to about the length of the carriage, measured between the front dog 53 and the rear dog 55.

On the far end of the outwardly extending shaft 57, as viewed in FIG. 5, or on the left-hand end as viewed in FIG. 6, another lug 65 is similarly fixed so that both the shaft 57 and the lug 65 rotate simultaneously. Lug 65 also has a finger that operatively coacts with another cam 61 that is pivotally supported by a similar bracket 63 to some adjacent immovable structure, such as the adjacent skid rails 29. The lug 65 is also shown in FIG. 5 at two locations 65 and 65a. As viewed in FIG. 5, the cam 67 is on the near side and the cam 61 is on the far side of the pivotable dog 53.

The rear pivotable dog 55 is shown in FIG. 4 in two operative positions 55 and 55a, and, like the front pivotable dog 53, is fixedly secured to a shaft 71 that has an outward extension on the near side, as viewed in FIG. 4. A lug 73 having a finger is also keyed, or otherwise suitably secured to the near side shaft extension so as to coact with a pivotable pawl 75 that is suitably mounted, about as shown in FIG. 4, to adjacent immovable structure.

The rear pivotable dog 55 has a downwardly extending tail portion 77 that is disposed angularly with respect to the main body portion of the dog 55 above the shaft 71. In the upright operative position, the main body portion of the rear pivotable dog 55 rests against an abutment or stop 79 fixedly secured to the carriage 17. In the down or pass position 55a, the tail portion 77 of the dog 55 engages another abutment or stop, such as a round bar 81 fixed to the frame 27, or to other suitable immovable structure.

The operation of the apparatus of the invention is automatic, being controlled in a way known to those skilled in the art whereby the apparatus functions at the proper time in accordance with a desired schedule. Continuously cast strands pass a conventional cutting station where the strands are severed into billets or slabs 11 of a finite desired length. The billets or slabs 11 are carried by the runout table rollers toward the material transfer apparatus 15 of the invention. But at the end of the runout table, each one of the billets or slabs 11 engages a movable stop 83 which is controlled from a central location in accordance with a preselected sequence. The stops 83 may be retracted either by an electronically controlled apparatus in an automatic manner, or by a manually operated control apparatus. The stops 83 are actuated by known means such as hydraulic cylinders, pneumatic cylinders, screw jacks, link mechanisms and the like.

After a single billet or slab 11, or after a plurality of billets or slabs 11 are released, when the stops 83 are retracted, the billets or slabs 11 pass onto the rollers 31 that carry the billets or slabs 11 in the direction of the arrow A. The billets or slabs 11 contact a fixed immovable stop 85 which is provided with a known type of shock absorber such as springs or hydraulic or pneumatic cylinder piston assemblies.

When the stop or stops 83 retract, they actuate a time delay relay in the electrical control system that allows the billet or slab time enough to reach and contact the fixed stop 85. Thereupon, motor 87 driving speed reduction unit 89 rotates the powered drum 41 in a counterclockwise direction, as viewed in FIG. 2. Rotation of the powered drum 41 in such a counterclockwise direction moves the carriage 17 in the direction of the arrow B; that is from right to left, as viewed in FIG. 2. The cable 33 being secured to the drum 41, winds onto the powered drum in one direction and off the powered drum 41 in the other direction.

Carriages 17 make a predetermined number of short lateral movements in the direction of arrow B. These movements remove cut billets or slabs from the transfer device 15 onto that portion of the skid rails 29 adjacent to the transfer apparatus. The length of these short movements of the carriages 17 is such to cause the dogs 55 on carriages 17 to traverse the length of driven rolls 31 on transfer device 15 and return to their original position, shown at the extreme right-hand end of FIG. 2. These short traverses of carriages 17 move billets or slabs from position Y on the transfer device rolls 31 to position Z on the skid rails 29.

A predetermined number of these short traverses, controlled by a counting device of known design on the drive for drums 41, establishes a group of billets or slabs in position "Z" FIG. 2 on skid rails 29. The cut billets or slabs occupy four different positions on this transfer apparatus. Position "Y," in which they are supported by rolls 31 and are separated; position "Z" in which they are first placed by carriages 17 and in which position, there is no air space between the vertical sides of the pieces; position "W" into which the billets or slabs are moved from position "Z" by dog 55 on carriage 17; and position "X" from which the billets or slabs are removed from skid rails 29. Position X is the position to which the billets or slabs are moved by front dog 53 on carriage 17.

When the carriage 17 moves in the direction of the arrow B, the front pivotable dog 53 initially is in the down or pass position 53a, and the rear pivotable dog 55 initially is in the up or operative position. The lugs 59 and 65 are in their respective positions 59a and 65a. The rear dog 55 first engages the billets or slabs 11 supported on the driven rolls 31 and moves such billets or slabs laterally in the direction of arrow B.

When the front dog 53 passes the pivotal cam 67, the lug 59, in position 59a, engages the cam 67; whereupon, rotation of the lug 59 raises the front dog to the operative or up position 53. The front dog 53 is now in position to contact and advance previously stacked billets or slabs 11a from position W to position X. The billets or slabs 11, being contacted by the rear dog 55, move with the carriage 17 from position Z to position W. Those skilled in the art will understand that the position Y is a first position, position Z is a second position, position W is a third position, and position X is a fourth position.

The carriage 17 is now ready to retract from a third position to its initial or first position. As the carriage moves to the right in the direction of the arrow C (FIG. 2), the lug 65 engages the pivotal cam 61 whereby the front pivotable dog 53 pivots counterclockwise to the down or pass position. In such down or pass position, the dog 53 does not contact the billets or slabs in positions W or Z, which are in the cooling positions.

As the right-hand end of the carriage 17 approaches the initial position, shown in FIG. 2, the lug 73 engages the pawl 75 and the rear dog 55 pivots counterclockwise from the operating or up position to the down or pass position. In such down or pass position, the rear dog 55 does not contact any of the billets or slabs 11 that have moved onto the table rollers 31 while the carriage was advancing billets or slabs toward the left.

Just before the carriage 17 reaches its initial position, the tail portion 77 of the rear dog 55 engages the fixed bar stop 81, as shown by the dotted outline construction in FIG. 2, and then, as the carriage continues to move in the direction of the arrow C, the rear dog 55 pivots clockwise to the upright or operative position in which it was located initially.

The carriage has now completed one cycle and has moved a first group of billets or slabs from the third position W to a fourth position X, and a second group of billets or slabs from a first position Y to the second position Z. A group of billets or slabs which have moved onto the transfer device while the carriage was advancing and retracting during one cycle, can now be moved from the first position Y to the second position Z, while the second group of billets are moved from the third position W to the fourth position X. The first group of billets at fourth position X will, of course, move toward the left when the second group of billets contact them, or this first group of billets may have already been removed in some other manner for further processing.

Those skilled in the art will recognize many important features and advantages of the present invention among which are:

That the billets or slabs may be transferred from a runout table onto a cooling bed or receiving table in an orderly and efficient manner;

That the billets or slabs may be arranged in two or several groups on the cooling bed as the occasion requires; wherefore, any difficulty that might arise because of an inaccurately formed or a bent billet, or a warped billet or slab, can be easily and readily corrected by removing the defective product without disturbing the other products; and

That the carriage of the apparatus moves a maximum of only two-thirds of the total cooling bed or receiving table product burden during any given traverse moment.

I claim:

1. In a continuous casting machine, apparatus for transferring unit lengths cut from a continuous strand formed in said machine, comprising:

- a. a plurality of skid rails disposed normal to said cast strand for supporting a plurality of unit lengths;
- b. a carriage movable along a path parallel to said skid rails;
- c. means to advance said carriage and said units along said path from first position to a second position;
- d. means to advance said carriage and said units along said path from said second position to a third position;
- e. means to retract said carriage to said first position;
- f. a front first dog pivotally mounted to said carriage and disposed in an inoperative position when said carriage is in the first position;

- g. a rear second dog pivotally mounted to said carriage and disposed in an operative position when said carriage is in the first position;
 - h. first cam means fixed pivotally in position alongside said path;
 - i. first means engageable with said first cam means for pivoting said front first dog from said inoperative position into an operative position as said carriage advances along said path, said front dog moving said unit lengths from said third position to a fourth position along said rails and said rear dog moving said unit lengths from a first position to said second position along said rails;
 - j. second cam means fixed pivotally in position along said path and in spaced apart relation to said first cam means;
 - k. second means engageable with said second cam means for pivoting said front first dog into said inoperative position when said carriage retracts along said path;
 - l. third cam means mounted pivotally along said path in spaced apart relation to said second and third positions;
 - m. third means engageable with said rear second dog to pivot the same to an inoperative position when said carriage retracts along said path;
 - n. fourth cam means located along said path in spaced apart relation to third cam means; and
 - o. fourth means engageable with said rear second dog to pivot the same to the operative position when said carriage approaches said first position.
2. The invention of claim 1 wherein:
- a. said means to advance and said means to retract said carriage includes a wire rope cable connected to said carriage and operatively looped around a rotatable drum; and including
 - b. means to rotate said drum.
3. In a continuous casting machine, apparatus for transferring unit lengths cut from a continuous strand formed in said machine, comprising:
- a. means extending normal to said unit lengths for supporting a plurality of said unit lengths cut from a continuous cast strand;
 - b. a carriage movable laterally in a direction normal to said unit lengths;
 - c. first means for moving said carriage and said units from a

- first position to a second position; and to a third position;
 - d. second means on said carriage engageable with at least one of said unit lengths for moving it from said first to said second position;
 - e. third means for retracting said carriage to said first position;
 - f. fourth means on said carriage for moving said one unit length from said third position to a fourth position when said carriage moves from said second position to said third position;
 - g. fifth means for moving said fourth means to an inoperative position as said carriage retracts; and
 - h. sixth means for moving said fourth means to an operative position when said carriage approaches said initial position;
 - i. seventh means for moving said second means to an operative position when said carriage reaches said initial position.
4. The invention of claim 3 wherein:
- a. said first means and said third means include a wire rope cable secured to said carriage and operatively looped around a drum that is reversible rotatable.
5. The invention of claim 3 wherein:
- a. said second means includes a first dog pivotally mounted to said carriage.
6. The invention of claim 3 wherein:
- a. said fourth means includes a second dog pivotally mounted to said carriage.
7. The invention of claim 3 wherein:
- a. said fifth means includes a first cam pivotally mounted alongside said carriage in a position to coact with said second dog to pivot the same to an inoperative position.
8. The invention of claim 3 wherein:
- a. said sixth means includes a second pivotal cam secured alongside said carriage in a position to coact with said second dog to pivot said second dog to an operative position.
9. The invention of claim 3 wherein:
- a. said seventh means includes a second fixed stop secured alongside said carriage in a position to coact with said first dog to pivot the same to an operative position.

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