ABSTRACT

A looper apparatus for forming in a moving strip of material such as a sheet metal strip one or more loops for temporarily storing a length of strip, comprising a loop car that engages the strip and travels in one direction along a track to form or enlarge a loop in the strip and travels in the opposite direction to diminish the loop. The apparatus includes arms mounted adjacent the track and adapted to be swung to an extended position in which they extend transversely of and overhang the track to support one leg of strip forming the loop as the car travels in its loop-enlarging direction, and to a retracted position in which the arms clear the track as the car travels in loop-diminishing direction. The means for swinging each arm includes a cam groove on the car that is engaged by cam follower means mounted on a member that is moved by the cam follower means to swing the arm to its extended and retracted positions. Means are provided to hold the arm in its extended and retracted positions.

15 Claims, 11 Drawing Figures
LOOPER APPARATUS FOR STRIP MATERIAL

FIELD OF THE INVENTION

This invention relates to looper apparatus for use with strip material, embodying at least one loop car that travels in a path to form a loop of strip material, and more particularly to means actuated by the car to move into and out of strip supporting position. Although the invention may be used in connection with the handling of various kinds of strip material, it provides exceptional advantages when used in processing lines for continuously processing steel strip, and therefore will be discussed below in connection with such use.

In lines of apparatus for processing steel strip in which it is desired to move the strip as continuously as possible, it is necessary to use means for forming loops in the strip at the feed end of the line, or at the takeoff end of the line, or at both places, or even in the line between the feed and takeoff ends, to provide temporary storage of a length of strip to permit the strip to move continuously even if there should be short halts or slow-downs in movement of a portion of the strip. These can occur when the leading end of a new coil of strip is attached to the tail end of a strip at the feeding end of the line, or a wound coil of strip is detached from the strip in the line and the strip in the line is then started on a coil winder at the discharge end of the line, or when the speed of travel of a portion of the strip is slowed or halted for other reasons. The use of looper means to maintain continuous movement of a strip at a constant rate is important in lines such as pickling or galvanizing lines where the strip could be harmed severely if the strip did not travel continuously at a uniform speed through the treating portions of the line. Properly designed and operated looper means can permit a satisfactory uniform rate of continuous travel of the strip through a processing line.

While various types of looper means are used, the present invention is directed primarily to the type in which one or more loops of strip are formed by a loop car that travels in a guided path, as on a track, in one direction to form or enlarge a generally horizontal loop of strip to increase the length of strip in the loop, and in the other direction to diminish the loop and the length of strip in the loop. Such a car usually carries a roller, rotatable about a horizontal axis, that engages the strip in the bight of a loop of the strip, and as the car travels in one direction along its path it forms in the strip an elongated generally horizontal loop of increasing length of strip; and as the car travels in the other direction it permits the length of the loop and of the strip in the loop to diminish.

As the car travels in the loop-enlarging direction, it is necessary that the strip in the upper leg of the loop be supported as the car passes and the loop enlarges, or else this part of the loop will sag into contact with the oppositely moving lower leg of the loop or parts of the apparatus, with consequent damage to the metal of the strip; the lower leg is usually supported by rollers above which the car travels and provides no support problems. Therefore, the upper leg of the loop is usually supported by arms pivoted along and beside the path of travel of the car, that are swung laterally into extended positions under the increasing upper leg of the strip as the car travels in its loop enlarging direction. As the car travels in the opposite loop diminishing direction, these arms are then swung back to retracted positions where they clear the path of the car before it reaches the location of each arm.

DISCUSSION OF THE PRIOR ART

Prior apparatus for swinging each arm between its extended and retracted positions has involved arm actuating means including a movable friction member associated with the arm structure, such as a wheel, that frictionally but impressively engages a portion of the car such as a side wall as the car travels, to swing the arm to the desired positions. Since the car travels at considerable speed, shocks of considerable magnitude develop as the car engages the friction means and the arm is started from a stationary condition, swung rapidly from one position to the other, and then halted. Despite the provision of shock absorbing mechanism to reduce such shocks and of detent means to hold the arm in the position into which it is moved, the shocks are often so great that the arm bounces back from the position to which it is moved. When an arm thus bounces back during loop enlarging travel of the car, the arm may swing back to a retracted position where it cannot support the strip, and sagging and damage to the strip can result. If on the other hand, an arm which is intended to be retracted bounces back into an extended position as the car travels toward the arm in the other or loop decreasing direction then the arm can strike the car or the strip or both; this can damage the car or strip, and can even wreck the car, with severe damage to the loop apparatus and strip as well as delays in production because the line must be shut down for repairs.

SUMMARY OF THE INVENTION

It is an object of this invention to provide apparatus in which the arm actuating means is such that the above disadvantages and problems can be completely avoided.

The invention provides looper apparatus comprising a car adapted to travel in a fixed path in opposite directions, arm means located adjacent the path and comprising an arm movable between an extended position transverse to the path and a retracted position where it clears the path and the car in the path, and means operated by movement of the car for moving the arm between such positions comprising cam means having a cam surface included in one of the arm means and the car, and cam follower means included in the other of the arm means and the car providing a cam follower that engages and follows the cam surface as the car moves, the cam means and cam follower means being arrayed so that relative movement between the cam surface and the cam follower moves the arm from its retracted to its extended position as the car moves in one direction and moves the arm from its extended to its retracted position as the car moves in the other direction. Preferably, the cam means comprises a cam groove having two confronting cam surfaces, and the cam follower travels in this groove.

Preferably the cam is shaped so that the arm moves slowly at the beginning of the engagement between said cam follower and the cam surface, more rapidly thereafter, and more slowly thereafter as said cam fol-
lower leaves the cam surface, to eliminate harmful shocks on starting and stopping movement of the arm.

Desirably, the cam means is mounted on the car and the cam follower means is mounted on the arm means. When arm means are mounted on opposite sides of the track, a cam means is mounted on each side of the car, and each of the arm means has a cam follower means adapted to engage the cam means on the associated side of the car.

The cam means and the cam follower means that engages the cam means are so located that as the car travels in one direction engagement of the cam follower means and the cam means causes the arm to move from its retracted to its extended position after the car passes, and as the car travels in the opposite direction engagement of the cam follower means and the cam means causes the arm to move from its extended to its retracted position to clear the car as it approaches.

Preferably the apparatus includes means for restraining the arm to hold it in each of its retracted and extended positions after it is moved to such position.

BRIEF DESCRIPTION OF DRAWINGS

These and other objects and features of the invention will become apparent from the following description of a preferred embodiment in connection with the accompanying drawings in which:

FIG. 1 is a somewhat diagrammatic side elevation to a small scale showing looper apparatus embodying the invention, the central portion of the loop long apparatus being broken out because of the apparatus length;

FIG. 2 is a plan of the apparatus of FIG. 1 to the same scale, framing portions and other parts being omitted for clearness;

FIG. 3 is a perspective to a larger scale of a loop car and associated apparatus including two opposite arm means the arms of which have been moved to their extended positions by the car;

FIG. 4 is an enlarged cross sectional view from line 4—4 of FIG. 3 of a portion of the looper apparatus of FIG. 1 showing a portion of the loop car and an arm in extended strip supporting position;

FIG. 5 is a plan of the portion of the arm supporting means illustrated in FIG. 4, showing the cam follower means in full lines in its position when the arm is extended, and in broken lines when the arm is retracted;

FIG. 6 is a section along line 6—6 of FIG. 5 and to the same scale as FIG. 4, and showing the cam follower means and its connection to the arm;

FIG. 7 is a section along the line 7—7 of FIG. 4 and to a larger scale, showing means for holding the arm in each of its advanced and retracted positions;

FIG. 8 is a diagrammatic plan showing a cam means and its groove on the car, that is engaged by the cam follower means of the various arm means along one side of the path traveled by the car, to move the arms between their two positions;

FIG. 9 is a plan to a smaller scale showing the loop car moving in loop enlarging position toward two arm means, the two opposite arms of which are retracted;

FIG. 10 is a plan of the portion of the apparatus of FIG. 9 to the same scale showing cam means on the car engaging cam follower means and the arms being moved to their extended positions; and

FIG. 11 shows the apparatus of FIGS. 9 and 10 immediately after the car cam grooves have disengaged from the arm cam follower means and the arms are in their fully extended positions.

DESCRIPTION OF PREFERRED EMBODIMENT

FIGS. 1 and 2 depict looper apparatus embodying the invention at the entry end of a strip steel continuous processing line, such as a pickling line. Strip 5 is supplied from a suitable source 1, which may be means for supplying steel from coils, and travels through the loop long apparatus 2 to a suitable processing line 3 such as a pickling line. While the looper apparatus illustrated is at the entry end of the line, similar apparatus may be used at the exit end of the line, and also maybe used in the line, to provide temporary storage of a length of strip. When the looper apparatus is used at the entry end of the line, the apparatus is capable of temporarily storing a length of strip sufficiently long so that strip can move out of the looper apparatus at a continuous rate and to and through the processing portion 3 in the line, even through the strip fed into the looper apparatus is temporarily halted, as to permit additional strip as from a coil to be joined as by welding to the tail end of strip entering the looper apparatus.

The illustrated apparatus comprises frame 4 having vertical members 5 carrying horizontal platforms 6, 7 and 8 carrying tracks 9 each made up of spaced parallel rails 10 (FIG. 3). Each track carries a loop car 12 that can travel along the track in either direction; in FIGS. 1 and 2 the cars are shown in full lines in extreme loop enlarging position, and in broken lines in extreme loop diminishing position. Each car 12 is positively moved along the track in its loop enlarging direction toward the right in FIG. 1, by a cable 13 attached to the end of the car facing loop enlarging direction. Cables 13 are all pulled simultaneously at the same rate by cable drums 14, 15 and 16 driven through suitable gearboxes 17 from vertical shafts 18 rotated by suitable power means 19 not shown. Drives 14, 15 and 16 are connected to the drive means through known means that permit the cars to be pulled by the strip in the loop diminishing direction as required. This means for pulling the cars is known and no further description is necessary.

Each car is ordinarily pulled in the other or loop diminishing direction by the tension in the strip as the length of strip in the looper apparatus is used up by strip leaving the apparatus when strip supplied to the looper apparatus is halted or slowed.

As shown in FIGS. 1-3, each car 12 comprises a rigid generally horizontal frame 20 having freely rotatable wheels 21 riding on rails 10 of the track on which the car travels. Each car also carries brackets 22 that freely rotatably support, about a horizontal axis extending at right angles to the strips, a large drum 23 around which the strip passes to form a loop.

At the end of the frame 4 toward which the cars move in loop diminishing direction, there are rotatable idler drums 24 around which the strip passes; if desired they may be adjustable in known manner to correct lateral strip alignment.

After the strip has been threaded through the looper apparatus around drums 23 of the loop cars and end drums 24, the strip is in a serpentine form (FIG. 1)
defined by loops L. As the loop cars are simultaneously drawn to the right in loop enlarging direction in FIG. 1, they draw strip at an increased rate from the source 1 and large horizontal loops of strip are formed, the length of strip in the loops depending on the maximum length of the tracks 9 and distance through which the loop cars move. Meanwhile, if desired the strip may be drawn from the looper apparatus at the desired constant processing speed. After the desired length of strip has been thus temporarily stored in the looper apparatus, the strip entering the apparatus may be slowed or halted for a short interval, as to permit the attachment of a leading end of another coil to the tail end of strip in apparatus. Since the strip is continuously leaving the looper apparatus, preferably at a constant speed, the strip is supplied during this interval from the looper apparatus and the loops diminish causing the loop cars to move to the left in loop diminishing direction.

After the supply of strip is resumed at the entry end of the apparatus, the speed at which it is supplied may be increased beyond that at which it is withdrawn from the looper apparatus so that loops can again be formed by movement of the loop cars in loop enlarging direction while strip leaves the apparatus at unchanged speed. Preferably the cars are maintained as much as possible in their extreme loop enlarging positions to permit storage of material within the looper apparatus for future needs.

As each loop car travels in its loop enlarging direction, the strip S in the lower leg 26 of the loop deposits on rollers 25 between the rails 10 as the loop becomes enlarged.

However, means must be provided for supporting the length of strip in the upper leg 27 of each loop, or otherwise it would sag and drag on the strip traveling in the lower leg in the opposite direction, or on the apparatus, causing damage to the strip.

In the illustrated apparatus, there are a number of arm means or units 30 positioned adjacent each track 9. Each unit 30 carries a generally horizontal arm 31 pivotal about a vertical axis A. As the loop car leaves each unit 30 while traveling in loop enlarging direction, the car causes each arm to move to its extended position in which it extends traversely of the path of travel, of the car under the upper loop leg 27, as shown in full lines in FIGS. 1, 2, 3, 4, 5 and 11. As the car travels in the opposite loop diminishing direction and approaches each unit 30 the car actuates each unit to swing its arm to a retracted position generally parallel to the path of travel of the car where it completely clears the car and the strip, as shown in broken lines in FIG. 2 and in full lines in FIG. 9.

Arm units 30 are mounted along each track 9 at intervals suitable to enable their arms when extended to support the strip in upper leg 27 of the associated loop so that it cannot sag sufficiently to drag on the strip in the lower leg 26. The units preferably are arranged in opposed pairs along the track, the units of each pair being identical except that one is a right hand unit and the other the left hand unit so that their arms when retracted extend in the same direction along the track and when extended are generally axially aligned (FIGS. 1, 2, 3).

As shown in FIGS. 3, 4, 5, each unit 30 comprises an upwardly extending stationary supporting member 32 fixed to frame 4 adjacent one of tracks 9. Member 32 has lugs 33 and 34 extending toward the track and pivotally supporting a generally vertical axis A movable supporting member 35 to which is fixed the arm 31. Arm 31 includes spaced upwardly extending brackets 36 that freely rotatably support, parallel to the arm, a roller 37 that non-frictionally carries and supports the strip in the upper leg 27 of each loop after the arm is extended between loop legs 26 and 27.

Means 38 acts between associated members 32 and 35 to retain each arm 31 in each of its extended and retracted positions after it is moved to such position, but to be overridden when the arm is moved by the car. The retaining means 38 illustrated comprises (FIGS. 3, 4, 5, 6) a lever 39 pivoted mounted between its ends about a vertical axis on a bracket 40 fixed to member 32. A roller 41 is rotatably mounted at one end of the lever, the other end of which is pivotally connected to a rod 42 passing through bracket 43 on member 32 and adjustably carrying at its outer end a spring-holding member 44. A compression spring 45 acts between bracket 43 and member 44 yieldingly to urge roller 41 toward movable member 35. Member 35 carries a radially extending cam portion 46 having two depressions or notches 47 and 48 separated by an arcuate portion 49. As indicated in FIGS. 5, 7 when the arm 31 is in extended position, roller 41 is located in notch 47 and holds the arm in that position; when the arm is in its retracted position, roller 41 is in notch 48 and holds the arm in that position. However, because the roller is yieldingly urged by the spring 45, the roller can be forced out of the notch in which it is located and roll along arcuate portion 49 to the other notch when portion 35 is turned to move the arm.

The means for moving each arm 31 between its extended and retracted positions (FIGS. 3, 4, 5, 7–11) comprises a cam follower lever or arm 51 rigidly fixed to and extending laterally of the movable member 35 to which arm 31 is fixed. Cam follower arm 51 carries an upwardly projecting cam follower roller 52 rotatable about a vertical axis B offset from rotational axis A of member 35.

Laterally and longitudinally projecting cam members 53, 54 (FIGS. 3, 8–11) are mounted on opposite sides of each loop car, the cam means or members 53 and 54 being identical except of opposite hand.

Cam members 53 and 54 respectively have downwardly open cam grooves 55 and 56. Each cam groove has confronting cam surfaces 57 and 58 and open ends 59 and 60 and are identical in shape except of opposite hand. Each groove is located so that the roller 52 on the end of the cam arm 51 of each arm unit 30 engages the cam groove as the cam member on the loop car passes the unit 30 carrying the cam follower.

The cam surfaces defining each groove 55 and 56 are shaped as indicated in FIGS. 8–11 so that as the car travels in enlarging direction (to the right in FIGS. 9–11) the cam follower rollers 52 of the two opposite arm units 30 nearest the car, the arms 31 being retracted, enter the ends 59 of the cam grooves 53 and 54, of the loop car (FIG. 9); as the rollers move relatively to the grooves the follower arms 51 on which they are mounted swing the members 35 about their
axes (FIG. 10) to move the strip supporting arms 31 toward their extended positions, in which they are located immediately after the car passes (FIG. 11).

Conversely, as the car moves in loop diminishing direction (to the left in FIGS. 9-11), toward a pair of arm units 30 the arms 31 of which are extended, the ends 60 of the grooves 55 and 56 of the cam members are aligned with the cam follower rollers 52, and the condition is as illustrated by FIG. 11. After the rollers engage the grooves and the car continues to move, the arms 31 swing toward their retracted positions, and conditions are as illustrated by FIG. 10. After the rollers leave the cam grooves, the arms 31 are fully retracted and conditions are as shown in FIG. 9.

The cam grooves are also shaped so that as the car travels in either direction the rollers 52 enter relatively flat portions of the cam grooves 55 and 56, and then more steeply slanted portions, and then relatively flat portions. Therefore each arm 31 moved by interaction of its roller 52 and the cam surfaces of the engaged cam grooves 55 or 56 starts to move slowly, then accelerates to move rapidly, then decelerates to move slowly as it leaves the groove, thus eliminating shocks at the ends of the arm travel that can cause undesired bouncing of the arms out of position. The cam members 53 and 54 are also located so that the arms move properly with relation to the car location so they are extended immediately after a car passes to support the strip, and are retracted immediately before the car approaches the arms, to avoid interference between arms and the car or strip.

The ends 59 and 60 of the cam grooves are widened as shown to permit easy entrance of the cam follower rollers as they enter the grooves.

By means of arm retaining means 38 the arm is held in the position to which it is moved by the cam means on the car until it is moved to the other position by such cam means when the car travels in the other direction.

Thus, the present invention completely avoids the difficulties discussed above when the friction means contacts the side of the car to swing the arm and it causes rapid acceleration and shock at the end of the arm swing which can cause the arm to bounce back into a position over the path when it should be at the retracted position or to bounce to a retracted position when it should be in an extended position.

The apparatus of the present invention operates positively and can provide for low initial acceleration and speed high intermediate acceleration and speed, and low final deceleration and speed of the strip supporting arms in their movements, to avoid possibilities of shocks. Since shocks that could cause the arm to bounce out of position are avoided, damage to the strip and car and loss of production from car wrecking or collision with the strip supporting arm are eliminated.

It is apparent that various modifications can be made in the above described embodiment without departing from the spirit of the invention. It is intended that the patent shall cover, by suitable expression in the appended claims, whatever features of patentable novelty reside in the invention.

1. Looper apparatus comprising a car adapted to travel in a fixed path in opposite directions; arm means located adjacent to said fixed path and comprising an arm adapted to be moved between an extended position transverse to said path and a retracted position where it clears said path and the car in the path; and means operated by movement of said car for moving said arm between said positions comprising cam means having a cam surface included in said arm means or said car, and cam follower means included in said arm means or said car providing a cam follower that engages and follows said cam surface as the car moves, said cam means and cam follower means being arranged so that relative movement between the said cam surface and said cam follower means said arm from its retracted to its extended position as the car moves in one direction and moves said arm from its extended to its retracted position as the car moves in the other direction.

2. The apparatus of claim 1 in which said cam surface is shaped so that the arm moves slowly at the beginning of the engagement between said cam follower and said cam surface, more rapidly thereafter, and more slowly thereafter as said cam follower leaves said cam surface.

3. The apparatus of claim 1 in which said cam means comprises a cam groove having two confronting cam surfaces, and in which said cam follower travels in said groove.

4. The apparatus of claim 3 in which said cam surfaces are shaped so that the arm moves slowly at the beginning of the engagement between said cam follower and said cam surfaces, more rapidly thereafter, and more slowly thereafter as said cam follower leaves said cam surfaces.

5. The apparatus of claim 3 in which the end of the groove first contacted by the cam follower is widened to facilitate entry of the cam follower into the groove.

6. The apparatus of claim 1 in which said cam means is mounted on said car and said cam follower means is mounted on said arm means.

7. The apparatus of claim 1 in which there are arm means located in opposite relation on each side of the path along which the car travels, and in which there is a cam means mounted on each side of the car, and in which each of said arm means has cam follower means adapted to engage the cam means on the associated side of the car.

8. The apparatus of claim 1 in which said cam means and the cam follower means that engages said cam means are so located that as the car travels in one direction engagement by the cam follower means with the cam means causes the arm to move from its retracted to its extended position after the car passes, and so that as the car travels in the opposite direction engagement by the cam follower means with said cam means causes the arm to move from its extended to its retracted position to clear the car as it approaches.

9. The apparatus of claim 1 comprising means for restraining the arm to hold it in each of its retracted and extended positions after it is moved to such position.

10. Looper apparatus comprising a car adapted to travel in a fixed path in opposite directions, arm means located adjacent said fixed path and comprising a supporting member rotatable about an essentially vertical axis and carrying a lateral arm for movement between an extended position transverse to said path and a
retracted position where it clears said path and the car in said path, cam follower means fixed on said supporting member comprising lever means carrying a cam follower; cam means on the side of the car at the side of the path on which said arm means is mounted, said cam means including a cam groove that is adapted to be engaged by said cam follower as the car passes said cam follower means, said cam groove having cam surfaces shaped to cause said lever means of said cam follower means to move said supporting member and turn said arm from its retracted to its extended position as the car moves in one direction and from its extended position to its retracted position when the car moves in the other direction.

11. The apparatus of claim 10 in which said cam groove is shaped so that when the cam follower first engages the groove the arm initially moves slowly and then accelerates at an increased rate to move rapidly during the intermediate portion of the groove and when the cam follower last engages the groove before it leaves the groove the arm moves slowly.

12. The apparatus of claim 10 comprising means for restraining the arm to hold it in the position to which it was moved by coaction of said cam means and said cam follower means.

13. The apparatus of claim 10 in which there are said arm means on each side of the path, each arm means having a cam follower means including a cam follower, and in which there are said cam means on each side of the car, said cam means and said cam follower means being adapted to move the arms of said arm means substantially simultaneously from their retracted to their extended positions as the car moves in one direction, and from their extended to their retracted positions as the car moves in the other direction.

14. The apparatus of claim 10 in which said cam means and said cam follower means are so related that as the car moves in one direction the arm moves from its retracted to its extended position after the car passes, and as the car moves in the other direction the arm moves from its extended position to its retracted position where it clears the car as the car approaches.

15. The apparatus of claim 10 in which each end of the cam groove is widened to facilitate entry of the cam follower into the groove.

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