April 9, 1940. R. J. WEAN ET AL 2,196,600

METHOD AND APPARATUS FOR TREATING STRIP

Filed Feb. 6, 1939 2 Sheets-Sheet 1

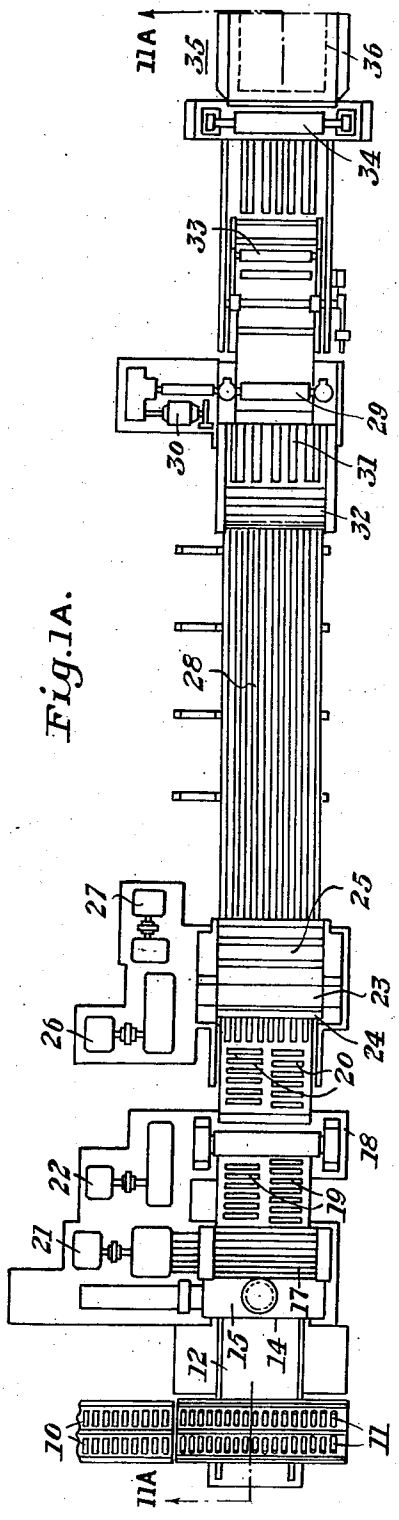


Fig. 1A.

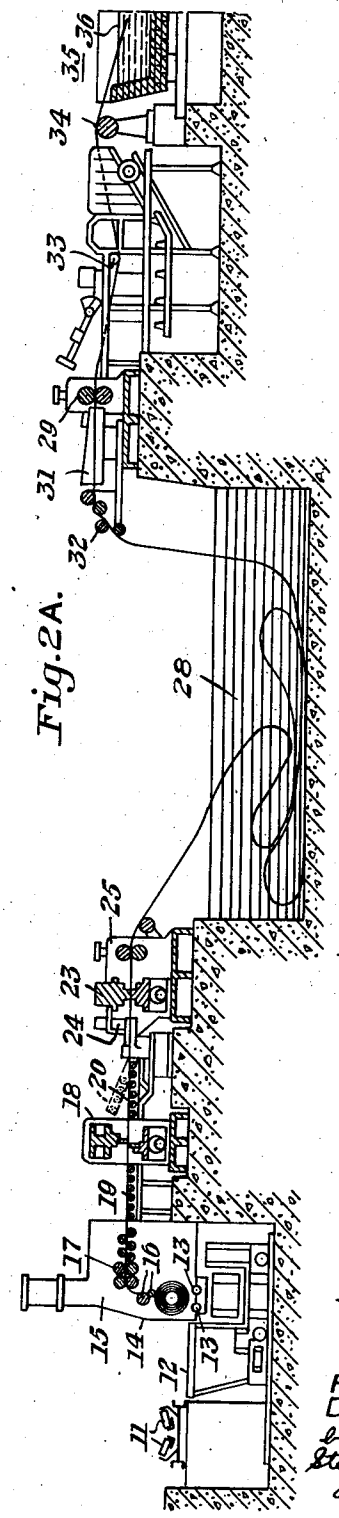


Fig. 2A.

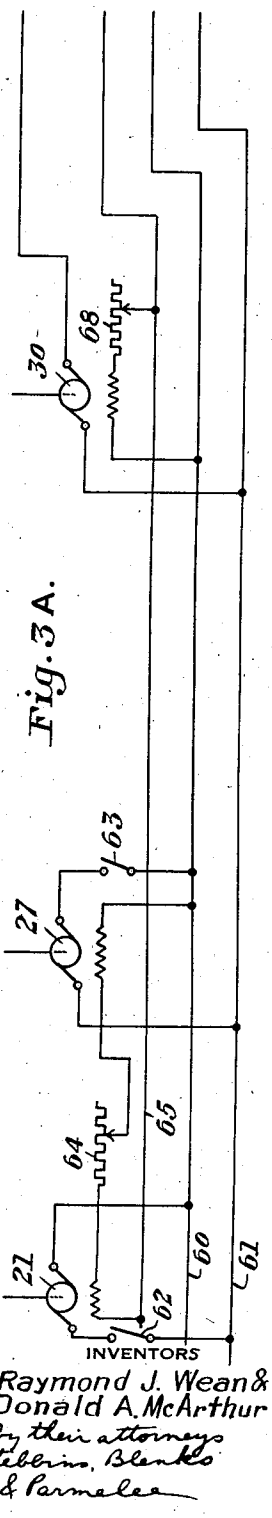


Fig. 3A.

INVENTORS
Raymond J. Wean &
Donald A. McArthur
by their attorneys
Stebbins, Blenko
& Parmelee

April 9, 1940. R. J. WEAN ET AL 2,196,600

METHOD AND APPARATUS FOR TREATING STRIP

Filed Feb. 6, 1939 2 Sheets-Sheet 2

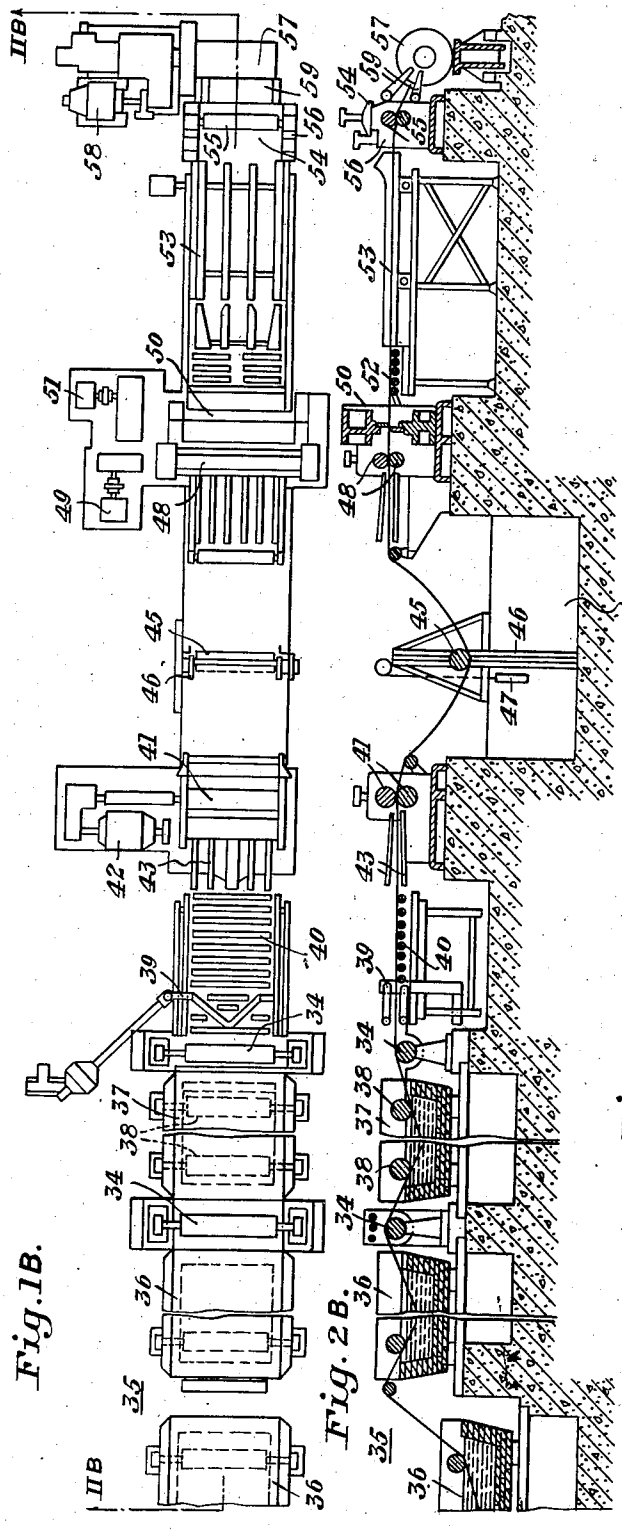


Fig. 1B.

Fig. 2B.

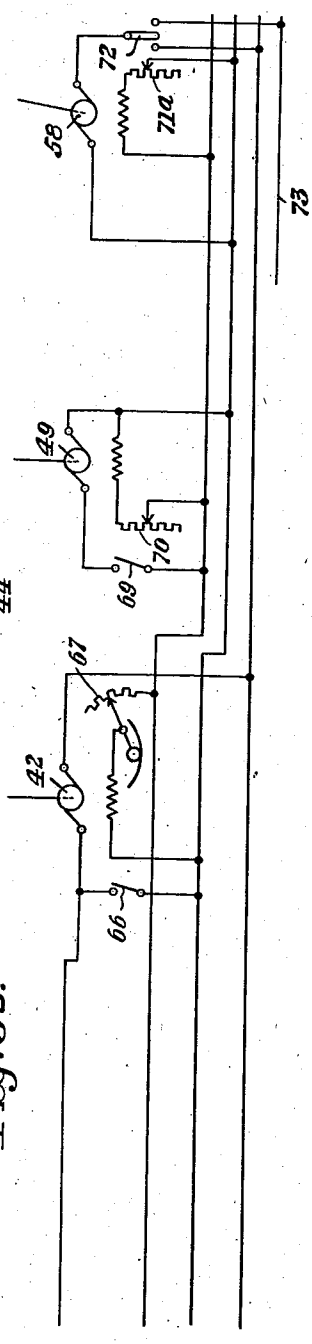


Fig. 3B.

INVENTORS
Raymond J. Wean &
Donald A. McArthur
by their attorneys
Stebbins, Blenko
& Parmalee

Patented Apr. 9, 1940 2,196,600

UNITED STATES PATENT OFFICE

2,196,600

METHOD AND APPARATUS FOR TREATING STRIP

Raymond J. Wean and Donald A. McArthur, Warren, Ohio, assignors to The Wean Engineering Company, Inc., Warren, Ohio, a corporation of Ohio

Application February 6, 1939, Serial No. 254,862

8 Claims. (Cl. 29—81)

This invention relates to a method and apparatus for the treating of strip material, and particularly to the continuous descaling of steel strip such as is produced on the well known continuous strip mills.

It has been proposed heretofore to descale strip by passing it through suitable treating apparatus, and securing the trailing end of one length of strip to the leading end of another to avoid the necessity of threading each length individually through the treating apparatus. It has been necessary, however, with the methods and apparatus heretofore used, to arrest the movement of the strip during the attachment of successive lengths together and their severance after completion of the treatment. This is objectionable because that portion of the material which remains in the treating apparatus during the attachment of severance of successive lengths is subjected to an excessive descaling treatment. Each stop means that the acid in the tank where the concentrated solution is carried will over-pickle the strip and particularly mark the strip at the surface level of the acid, leaving what is called "a pickle-etched" stain. At both ends of the catenary this will be repeated on the second stop, and when the strip goes to the cold mill for further reduction and elongation, these particular spots or marks across the strip are also elongated and when the material is sheared and inspected, all such sheets have to be thrown out as rejections. Another objection to the methods and apparatus previously employed is that they did not provide the desired flexibility of operation or control.

We have invented a method and apparatus for treating strip which overcomes the aforementioned objections and makes it possible to move the strip continuously through the treating apparatus, even while successive lengths are being attached or severed. This ensures that all portions of the strip are subjected to precisely the same descaling treatment with the result that a high degree of uniformity in the product is obtained. A further feature of our invention is that a high degree of flexibility in the control and operation thereof is obtained by making the drives for the several parts of the apparatus independent of each other. Other novel features and advantages of the invention will become apparent as the description thereof proceeds.

The accompanying drawings illustrate diagrammatically a preferred form of the apparatus of the invention which we employ to practice the method thereof. In the drawings:

Figures 1A and 1B together constitute a plan view of descaling apparatus in accordance with the invention;

Figures 2A and 2B together constitute a vertical longitudinal sectional view taken along the line IIA—IIB of Figures 1A and 1B, together with elemental control circuits for the motors driving the various units; and

Figures 3A and 3B constitute a circuit diagram.

For convenience and clarity, the following detailed description of the invention will be divided into three parts, as follows:

(1) The apparatus;
(2) The control;
(3) The method.

The apparatus

Hot rolled strip in coils, with an adherent layer of scale thereon, is delivered to the entry end of the apparatus by any convenient means, such as a gravity conveyor 10. The conveyor is provided with a tilting section 11 which, when operated, discharges the coil thereon down a slope 12 onto cradle rolls 13 of a processing uncoiler 14. This device is well known in the steel industry and requires no detailed description. Briefly, it consists of housings 15, pinch rolls 16 and leveling rolls 17 which subject the material to a mild cold working as it is drawn therethrough while the coil is supported on suitable means for the unwinding operation. The material is rendered more plastic by passing through the uncoiler and less likely to development of cross breaks.

A squaring shear 18 is spaced from the discharge end of the coiler 14. A roller conveyor 19 extends between the uncoiler and the shear. The rolls of the conveyor are in two groups and are staggered to prevent the advancing end of a strip from catching between adjacent rollers. On the opposite side of the shear 18 from the conveyor 19 is a tilting conveyor section 20, the alternate position of the conveyor section being shown in dotted lines. The conveyor is shifted to the dotted-line position when the leading end of a coil of strip is passed through the shear. After the shearing, the conveyor section is lowered and the scrap end is permitted to fall into a chute.

The strip is fed through the uncoiler 17, the shear 18, and over the conveyor sections 19 and 20 by driving the uncoiler. The latter is provided with a motor 21 shown in plan in Figure

1A and diagrammatically in Figure 2A. The shear 18 is driven by a motor 22.

Beyond the tilting conveyor section 20 is located a stitcher 23 which is similar to the shear 18 except that it is provided with punches and dies instead of shear knives. The stitcher has a hold-down piston 24 reciprocating in a suitable cylinder and operated by pneumatic pressure. The stitcher is also provided with pinch rolls 25 for cooperating therewith in securing to the trailing end of a coil which has previously passed through the apparatus, the leading end of a succeeding coil. The stitcher is driven by a motor 26 and the pinch rolls 25 by a motor 27.

A looping pit 28 is disposed beyond and below the pinch rolls 25. The pit is preferably thirty or forty feet long so as to accommodate a fair length of strip when piled loosely therein, as indicated in Figure 2A.

Pinch rolls 29 driven by a motor 30 are disposed adjacent the end of the pit 28 opposite that at which the pinch rolls 25 are located. Guides 31 direct strip from the pit 28 into the pinch rolls 29. As the strip emerges from the pit, it passes between rolls 32 which unfold any transverse bends or creases which may have been formed in the strip while it lay in the pit, by the weight of the several loops thereof.

From the pinch rolls 29 the strip passes under a so-called "dancer" roll 33 over a guide roll 34 and into descaling apparatus indicated generally at 35. The dancer roll is simply an idle roll mounted on an oscillatable frame, the function of which is to control the slack in the strip as it passes through the descaling apparatus 35 by suitably adjusting the speed of the motors driving the pinch rolls which advance the strip.

The descaling apparatus illustrated consists of a plurality of pickling tanks such as that illustrated at 36, and one or more wash tanks 37. The first tank 36, as shown, is at a level lower than that at which the other pickling tanks are disposed. This permits gravity-flow of nearly spent acid to the first tank from the other tanks, with a considerable economy, as the solution in the first tank does not have to be very strong. With this arrangement, fresh acid is added only to the pickling tanks subsequent to the first. Guide rolls, such as that shown at 34, are provided at each end of each pickling tank, and hold-down rolls 38 are mounted in the wash tanks.

Adjacent the exit end of the last-mentioned tank is located an air drier 39 which dries the strip by subjecting it to jets of warm air as it passes over a conveyor 40.

Pinch rolls 41 driven by a motor 42 are located beyond the drier 39 and are provided with guides 43. The pinch rolls 41 cooperate with the pinch rolls 29 to maintain the desired tension on the strip between them, so that loops of suitable depth to give the proper immersion of the strip in the pickling tanks will be obtained.

While we have illustrated pickling tanks as the descaling apparatus, any other apparatus capable of removing the scale from the strip may be substituted therefor, for example, centrifugal blasting apparatus.

A second looping pit 44 is disposed adjacent the pinch rolls 41. It is provided with a dancer roll 45 reciprocable between vertical guides 46 and having a counterweight 47. The dancer roll 45 maintains a loop of variable size in the pit 44.

Pinch rolls 48 driven by a motor 49 cooperate with the pinch rolls 41 to maintain a loop of strip in the pit 44, as illustrated, under normal running conditions. A shear 50 driven by a motor 51 is similar to that shown at 23 and serves to cut out the stitched joint between successive lengths of strip when they have passed through the treating zone, e. g., the pickling tanks, wash tanks and drier.

A tilting conveyor section 52 is located beyond the shear 50 for the same purpose as the tilting section 20 adjacent the shear 18. The conveyor section 52 is carried on a table 53 having skids leading from the section 51 to an oiler 54. The latter includes a pair of polished rolls 55 journaled in suitable housings 56 and provided with means (not shown) for directing oil jets onto the rolls. The latter apply a film of oil to the strip passing therebetween.

A recoiler 57 is disposed adjacent the oiler and is driven by a motor 58. Guides 59 serve to direct strip issuing from the oiler into the recoiler. The latter, of course, recoils the strip for delivery or further processing operations.

The control

The uncoiler motor 21 has its armature connected across busses 60 and 61 in series with a main switch 62. For simplicity, the latter is illustrated as a manual switch in one side only of the circuit between the motor and the busses. It will be understood that this showing is purely diagrammatic, and that main switches, such as that indicated at 62, will usually take the form of electromagnetic contactors having push button or other remote control. The motor 27, driving the pinch rolls 25, may similarly be connected to the busses by a switch 63. The motors 21 and 27 and the speed reducers through which they are connected to the uncoiler and the pinch rolls are designed so that the peripheral speed of the uncoiler rolls and the pinch rolls will be approximately the same. In order to permit variations in this speed, we provide a rheostat 64 for controlling the field windings of the motors 21 and 27. The latter are connected in series with the rheostat 64 between the main bus 60 and an excitation bus 65.

The motors 30 and 42 driving the pinch rolls 29 and 41, which feed strip to the descaling means and draw it therethrough, respectively, are operated continuously. They are simultaneously connected to the main busses by the closing of a switch 66, and the speed of the motor 42 is equalized with that of the motor 30 by a rheostat 67 connected in the circuit of the field winding of the motor 42 and actuated by the dancer roll 33. A rheostat 68 in the circuit of the field winding of the motor 30 permits the speed of the latter to be controlled as desired.

The motor 49 driving the pinch rolls 48 may be connected across the main bus by a switch 69. The speed of this motor is normally controlled by a rheostat 70 in the field circuit thereof.

The motor 58 may be connected across the main busses by moving a switch 72 to the left. It may also be connected across the bus 60 and an auxiliary bus 73 by moving the switch 72 to the right. The bus 73 is connected to a current source having a voltage higher than that of the bus 61, whereby high speed operation of the motor 58 is obtained for purposes which will be explained shortly. A manual field rheostat 71*a* provides for adjustment of the speed of the motor 58.

The method

The coil 14, delivered to the tilting section 11 of the conveyor 10, is discharged onto the slope

12, and thence onto the cradle rolls of the uncoiler. The motor 21 is then energized by closing the switch 62 to feed the end of the coil between the pinch rolls 16 and the leveling rolls 17 across the conveyor section 19 and through the shear 18. When the end of the coil has passed through the shear, the motor 21 is stopped and the shear operated to crop the leading end of the strip and provide a square end. During this time, the trailing end of the previous strip length is disposed between the jaws of the stitcher 23.

The squared end of the new coil is again fed forward by energizing the motor 21. The leading end of the new coil is then laid on top of the trailing end of the preceding coil, overlapping it by approximately one foot, the overlap being between the dies and punches of the stitcher. Operation of the stitcher motor 26 causes the punches and dies to form interengaging lugs and slots in the two strip ends. To lock the stitch, it is subjected to tension. The hold-down 24 is advanced so that it grips the end of the new coil. The motor 27 driving the pinch rolls 25 is then energized to exert a pull on the trailing end of the preceding strip length. As a result, there is a slight relative movement between the two strips and the stitch is locked. The hold-down 24 is then raised and the motors 21 and 27 simultaneously energized to pass the strip through the pinch rolls 25 for the purpose of flattening it. After the strip has passed through the pinch rolls 25, one of the pinch rolls is retracted relative to the other whereby to release the grip previously exerted on the strip thereby.

While the operations just described are being effected, the pinch rolls 29 and 41 continue to operate to feed through the descaling zone the excess strip accumulated in the looping pit 28. This excess strip is provided by operating the uncoiler at a speed which will deliver strip to the pit faster than it is drawn therefrom by the pinch rolls 29. As shown in the circuit diagram, the motors driving the pinch rolls 29 and 41 are independent of all the other motors so that they are not affected by the operations necessary to attach one length to another or, as will be described presently, to sever successive lengths after they have been descaled. It will also be apparent that the control system provided for the motors 21 and 27 permits the uncoiler 14 and the pinch rolls 25 to be operated independently or together and, if the latter, their speeds can be jointly varied. This independence between the speeds of operation of different portions of the apparatus is one of the important advantages of the invention.

The dancer roll 33 operating the rheostat 67, as already indicated, causes the speed of the motor 42 to be so adjusted relative to that of the motor 30 as to maintain the proper amount of material between the pinch rolls to provide the desired depth of immersion of the material in the several pickling and wash tanks.

Under normal running conditions, the recoiler 57 is operated at a speed sufficient to coil the material substantially as fast as it is delivered from the descaling zone. The upper roll of the pinch rolls 48 is retracted and the motor 58 is controlled by the rheostat 71*a* to maintain the desired loop in the pit 44. This loop is preferably a minimum as the end of a length approaches and a maximum after cutting out the stitch and starting a new coil, but no piling up of material in the pit 44 should be permitted as scratches would result.

When the stitch comes along, the operator lowers the top roll of pinch rolls 48 and stops the pinch roll motor 49 and the coiler motor 58. The shear 50 is then operated to make a cut just ahead of the stitch. As soon as this has been done, the coiler motor 58 is driven at maximum speed by moving the switch 72 to the right. The free end of the preceding strip length is thus wound up quickly on the recoiler. As soon as it has been completely coiled, the motor 58 is stopped, the coil is removed from the coiler spindle by any convenient means, and preparations made to attach the leading end of the succeeding strip thereto. In the meantime, the pinch rolls 48 are driven by energizing the motor 49 to pass the stitch through shear 50. After stopping the motor 49, a second cut is then made to sever the stitched joint. The motor 49 is again started and the pinch rolls 48 feed the leading end of the succeeding strip length across the conveyor 52 and the table 53 between the rolls of the oiler 54 and the guides 59 to the recoiler spindle to which it is secured.

During the severing of the stitched joint, strip continues to issue from the pinch rolls 41, increasing the size of the loop in the pit 44. The operation of cutting out the stitch and starting the succeeding length of strip onto the coiler is usually completed before the loop reaches the bottom of the pit 44. To prevent further piling up of strip the motors 30 and 42 can be slowed down by rheostat 68. Slowing down the strip in the pickling tanks is not objectionable as it does not mark the strip as a complete stop does. The accumulated excess of strip in the pit 44 is gradually removed after the leading end of the following length of strip has been started on the coiler by reconnecting the motor 58 to the bus 61, retracting the top roll of pinch rolls 48, and controlling the speed of the motor by the manual rheostat 71*a*.

Normal operations continue until the trailing end of the length being uncoiled approaches the shear 18. At that time, the uncoiler motor 21 and the pinch roll motor 27 are stopped. The shear 18 takes a cropping cut from the end of the strip. The pinch roll motor 27 is again energized to advance the squared end of the strip to the stitcher 23 where it awaits the squared leading end of the succeeding strip length.

It will be apparent from the foregoing description that the invention is characterized by numerous features of advantage. In the first place, the strip is fed continuously through the descaling zone so that all portions thereof are subjected to precisely the same treatment. The speed of the motors driving the pinch rolls which forward the strip through the zone is such that the desired descaling treatment will be effected. The control of these motors is entirely independent of all the other devices, and the provision of the looping pits makes it possible to attach successive lengths together and shear them apart without stopping the travel of the material through the descaling zone.

The uncoiler not only prevents fluting and cross breaks but also loosens the scale on the strip to a certain extent, facilitating final scale removal. It also permits the material to pile in the looping pit 28 without injury.

The conveyor section 19 permits the free end of a coil to be fed forward without catching or interference, while the section 20 disposes of scrap automatically. The pneumatic hold-down expedites locking of the stitched joint, and the stitcher provides an effective connection between lengths.

The stitcher pinch rolls and the shear pinch rolls grip the strip only when stitching or shearing so that accurate matching of the speed of these rolls with that of the other parts is not necessary.

The arrangement of the drier is such as to blow the moisture off the strip so that it dries very quickly.

Although we have illustrated and described but one preferred embodiment and practice of the invention, it will be understood that changes in the construction or procedure may be made without departing from the spirit of the invention or the scope of the appended claims.

We claim:

1. In a method of treating coiled strip having an adherent but removable surface layer thereon, the steps including unwinding a coil of strip, advancing the end thereof longitudinally along a predetermined path, maintaining the strip continuously in motion while traversing one portion of said path, removing said layer progressively while the strip traverses said portion of its path, accumulating an excess of strip at a point in said path ahead of said portion, unwinding a second coil and attaching the leading end thereof to the trailing end of said first-mentioned coil whereby to maintain continuity of strip movement in said portion of its path, accumulating an excess of strip at a point in said path beyond said portion, and shearing the first-mentioned coil from the second after the leading end of the latter has traversed said portion.

2. In a method of treating coiled strip, the steps including uncoiling a length of strip, advancing the leading end thereof, and passing the strip continuously through a descaling zone, attaching the leading end of a second length to the trailing end of the first, arresting the junction between the lengths, shearing the trailing end of the first length from the leading end of the second after the latter has traversed said zone, while maintaining continuous movement of the second length through said zone, and accumulating an excess of strip between said zone and the point of shearing.

3. In a method of treating coiled strip, the steps including uncoiling a length of strip, advancing the leading end thereof, and passing the strip continuously through a descaling zone, attaching the leading end of a second length to the trailing end of the first, shearing the trailing end of the first length from the leading end of the second after the latter has traversed said zone, while maintaining continuous movement of the second length through said zone, and accumulating an excess of strip between said zone and the point of shearing.

4. In a strip descaling line, the combination with an uncoiler, a stitcher adapted to join the adjacent ends of successive coils of strip, a looping pit adapted to receive surplus strip, descaling means, means for continuously feeding strip through said means, a shear for severing adjacent coils, a recoiler adapted to receive and coil descaled strip, and a looping pit between the descaling means and the recoiler.

5. In a strip handling apparatus, the combination with an uncoiler adapted to unwind strip from a coil, and pinch rolls cooperating therewith to feed the strip forward, of a motor for driving the uncoiler and a motor for driving the pinch rolls, separate means for starting and stopping said motors, and common means for varying the speed of said motors.

6. In a strip handling apparatus, the combination with descaling means, a stand of pinch rolls at each end of said means for passing strip therethrough, of a motor driving each stand of pinch rolls, common means for starting and stopping said motors, and independent speed control means for each of said motors.

7. Strip-handling apparatus comprising an uncoiler, feed-in pinch rolls, entering and exit descaler pinch rolls, feed-out pinch rolls and a coiler, separate motors for driving said elements, and common means for controlling the motors driving said descaler pinch rolls independently of the motors driving the other elements.

8. In a method of treating strip, the steps including passing strip continuously through a descaling zone, normally coiling it at a point beyond said zone substantially at the same rate at which it is passed through said zone, severing the strip into two pieces at intervals, arresting the leading end of the trailing piece while continuing to pass the body of the trailing piece through said zone and accumulating excess strip between said zone and the point of severance, coiling the trailing end of the leading piece, then coiling the leading end of the trailing piece at a rate greater than that at which it is passed through said zone.

RAYMOND J. WEAN.
DONALD A. McARTHUR.