

[54] **METHOD AND APPARATUS FOR
SCRAP COIL TRANSFER IN
CONTINUOUS STRIP PROCESSING
LINES**

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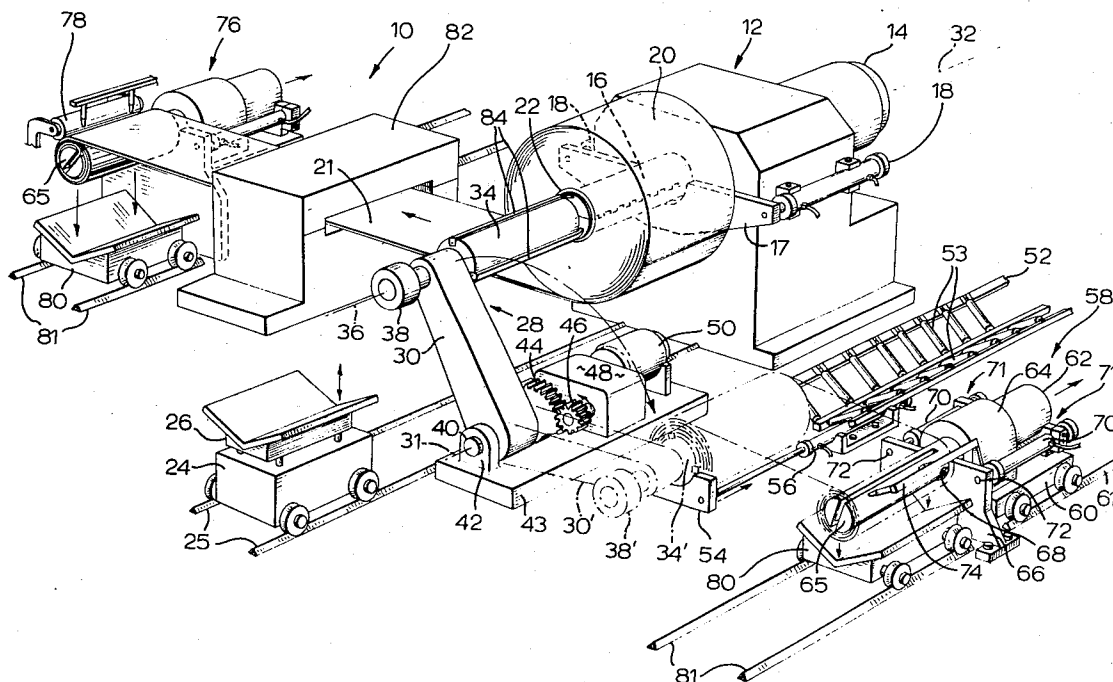
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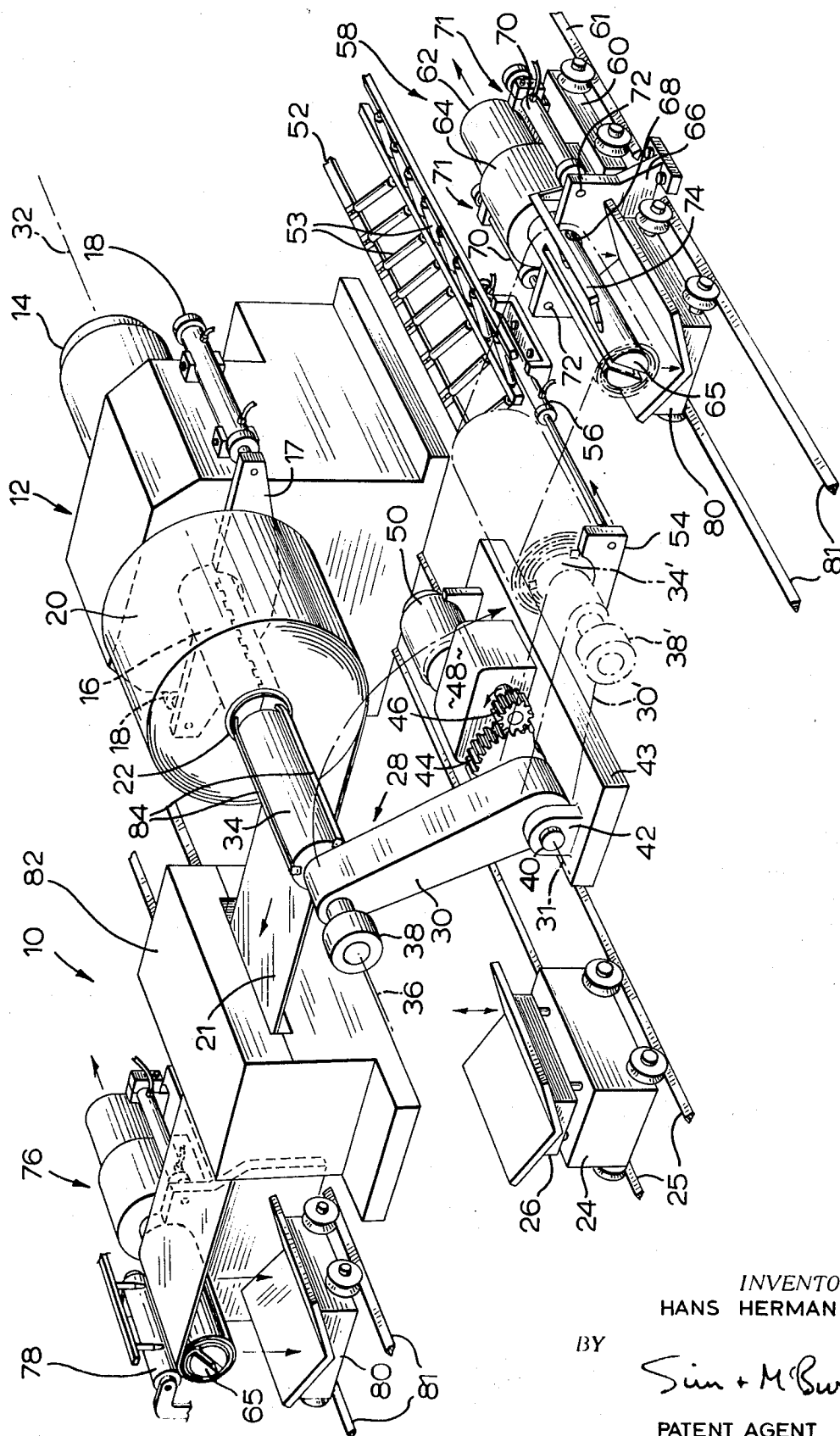
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[57] **ABSTRACT**

An apparatus and method are disclosed for accelerating the usually time-consuming operation, in a continuous strip-processing line, of removing the tail-end scrap from the line prior to bringing in a new coil. A swingable arm supports a transfer mandrel which aligns with the conventional pay-out mandrel in one position, and can swing to another position out of the way of an incoming new coil. After a given coil has been run down to the tail-end scrap, its rotation is halted, the strip is severed, the scrap coil is pushed off onto the aligned transfer mandrel, and the latter is swung to the other position where a conventional scrap-coiler unwinds the tail-end scrap from the transfer mandrel.

8 Claims, 1 Drawing Figure





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METHOD AND APPARATUS FOR SCRAP COIL TRANSFER IN CONTINUOUS STRIP PROCESSING LINES

This invention relates generally to single pay-off continuous strip processing lines of the kind utilized in steel plants for performing certain continuous operations on rolled steel strip.

GENERAL BACKGROUND OF THE INVENTION

Single pay-off continuous strip processing lines are designed to perform certain operations on rolled steel strip, which, when it emerges from the rolling process, is coiled about an expandable mandrel or about a tubular sleeve. When tightly coiled in this manner, it is known as a coil. These coils can be of varying sizes, depending on the length of strip coiled, but their diameter varies generally from about 2 feet to as much as 6 or 8 feet. To avoid confusion of terminology in this specification, the term "A-coil" will be applied to all rolls which consist of a single piece of steel strip which has just emerged from the rolling operation. Each length of strip which is coiled into an A-coil is made as a single piece from an ingot. The ingot goes through a series of rolling operations and annealing steps as it is attenuated to form the strip. In the last of the rolling operations necessary to form the steel strip, the pressure rollers are of necessity set very close together, since the strip at this point has a very small thickness, of the order of $1/16$ th to $1/4$ inch. Naturally, so long as the strip is in the nip of these rollers, the rollers do not contact each other, and no damage can be done to them. If, however, the steel strip should "run out" between the nip of the rollers while the rollers were under full nip pressure, they would immediately come into contact and damage would result. Thus, it is the practice to slack off the rollers and to move the final rollers a slight distance apart as the tail-end of the steel strip approaches. This results in an off-gauge thickness (i.e. slightly greater than that of the main portion of the strip) at the tail-end of the strip.

A slightly greater thickness than desired also occurs at the front end of the strip, since the front end cannot be fed between the nip of the final rollers when these are under full pressure. It is necessary first to get the strip feeding through the nip of the rollers while these are at a low pressure, and then gradually increase the pressure of the rollers to that which will produce the required gauge of thickness.

Thus, each A-coil has a front-end portion of off-gauge thickness and a tail-end portion of off-gauge thickness.

An example of a continuous strip processing line in which the method and apparatus of this invention find use is one in which the edges of the strip are trimmed to give the strip a uniformity of width. Commonly, the edge-cutting processing line is also used to combine a number of the smaller A-coils into a single, larger coil which is made up of the central, on-gauge portions of the A-coils. These larger coils will be referred to hereinafter as B-coils. In the conventional process for manufacturing B-coils from A-coils, the steps are as follows. A first A-coil is placed on the horizontal pay-off mandrel of the pay-off reel at one end of the processing line, and the front-end portion of the strip, which is of greater than desired thickness, is wound onto a scrap coiler in the processing line until a gauge detector

mechanism indicates that all of the off-gauge portion has been wound onto the scrap coiler. The strip feed is then halted, and the strip is cut in the on-gauge portion, usually at an oblique angle. The cut produces a "leading end" of on-gauge strip, and this leading end is fed through the edge-cutters, and then wound onto a mandrel or a sleeve. The on-gauge portion of the strip in the first A-coil continues to pass through the processing line until the gauge detector indicates that the tail-end portion of off-gauge thickness has begun to feed. At this point the line is again shut down, and another oblique cut is made on the on-gauge portion. Then, the remaining tail-end scrap of off-gauge thickness is pushed from the pay-off mandrel onto a special telescoping and tilting "coil unloader" positioned in front of the pay-off mandrel. The coil is then lowered and retracted to clear the path for a new incoming A-coil. When the second A-coil is in position on the pay-off mandrel, the same process is repeated. This time, after the first cut has been made (subsequent to the coiling up of the front-end portion of off-gauge thickness), the leading edge of the on-gauge central portion of the second A-coil is welded to the trailing edge of the on-gauge material of the first A-coil, and then the line is started up again to feed the central portion from the second A-coil. This process continues using a number of A-coils, until a B-coil of the desired diameter has been formed.

The B-coils are then removed either to another processing line for further treatment or to direct sale to manufacturers of products such as duct work, sheet-metal hoods, metal containers, etc.

The coiled tail-end scrap stripped from the pay-off mandrel after the processing of the on-gauge central portion of each A-coil is then rolled out on the floor for sleeve and scrap separation. The scrap is wound onto a separate full size coiler, and subsequent tail-end scrap portions from subsequent A-coils are welded to each previous portion so that a large coil of off-gauge scrap can be formed. Where the coil has been wound on a tubular sleeve, the latter, which remains on the pay-off mandrel when the coil scrap has been stripped therefrom, is then removed either by a "coil unloader" or by the use of the coil delivery car, and is rolled out onto the floor for pickup.

DISADVANTAGES OF THE PRIOR ART

The primary disadvantages of the prior art relate to the length of time required for removing the scrap coil and the sleeve from the pay-off mandrel. It is highly desirable, on a high speed line such as that described above, to increase the line running time as a percentage of total time, and one of the hindrances to such an increase in percentage of running time is the involved process of removing the tail-end scrap and the sleeve from the pay-off mandrel.

OBJECTS OF THIS INVENTION

The primary object of this invention is to reduce the time and the handling required for the removal of tail-end scrap and the tubular sleeve from the pay-off mandrel.

A further object of this invention is to increase the percentage of line running time as compared to total time.

Yet a further object of this invention is to reduce the personnel necessary to handle sleeve and scrap separation as well as scrap disposal on a high speed line such as that described above.

GENERAL DESCRIPTION OF THE INVENTION

Generally, the above objects are achieved by the provision of an apparatus having a transfer mandrel which can be swung between a first position in which it is aligned with the pay-off mandrel and can receive the tail-end scrap as well as the tubular sleeve on which it is wound and a second position where it is swung out of the way of the pay-off mandrel, and from which the tail-end scrap can be wound onto a scrap coiler whose mandrel is in juxtaposed relation with the transfer mandrel in the second position. With the transfer mandrel swung out of the way into the second position, a new A-coil can immediately be brought up to and fitted on the pay-off mandrel. In this way, the front end scrap of the new A-coil and the tail-end scrap of the previous A-coil can be coiled up simultaneously on two different scrap coilers.

In particular, this invention provides, in a continuous strip processing line, apparatus for the rapid removal of tail-end coil scrap from a cantilevered horizontal pay-off mandrel including stripper means, the apparatus comprising: an arm member mounted for pivotal movement about a fixed horizontal axis spaced a given distance from the pay-off mandrel axis and parallel therewith, a transfer mandrel mounted on the arm member for rotation about an axis parallel to said fixed horizontal axis and spaced said given distance from said fixed horizontal axis, the arm member being swingable between a first position in which said transfer mandrel is aligned with and in proximity to said pay-off mandrel and a second position in which the transfer mandrel is remote from said pay-off mandrel, power means for selectively swinging the arm member between said first and second positions, brake means for resisting the rotation of the transfer mandrel with respect to the arm member, and scrap coil means including a scrap coiler mandrel parallel and in juxtaposed relation to the transfer mandrel when the arm member is in said second position, whereby coil scrap on the pay-off mandrel can be stripped off the latter onto the transfer mandrel when the arm is in said first position, whereupon the arm member can be swung to said second position in which the scrap coiler means can remove the coiled scrap from the transfer mandrel.

This invention also provides, in a continuous strip processing line which includes a pay-off reel having a cantilevered horizontal pay-off mandrel including stripper means, a method of changing coils of strip, each of which has a front-end and a tail-end portion of an off-gauge thickness, said method comprising the steps: providing an arm member mounted for pivotal movement about a fixed horizontal axis spaced a given distance from the pay-off mandrel axis and parallel therewith, a transfer mandrel mounted on said arm member for rotation about an axis parallel to said fixed horizontal axis and spaced said given distance from said fixed horizontal axis, the arm member being swingable between a first position in which said transfer mandrel is aligned with and in proximity to said pay-off mandrel and a second position in which the transfer mandrel is

remote from said pay-off mandrel; swinging said arm member away from said first position, placing a first coil in position on said pay-off mandrel, winding the front-end portion of said first coil onto a scrap coiler in the processing line, halting the movement of the strip, severing the strip where its thickness is on-gauge, running the strip through the processing line until the tail-end portion of off-gauge thickness begins to feed from the coil, halting the movement of the strip, severing the strip where its thickness is on-gauge, swinging the arm member to said first position, stripping the coiled tail-end portion from the pay-off mandrel onto the transfer mandrel, swinging the arm member to said second position, and removing said tail-end portion from the transfer mandrel while simultaneously placing a second coil in position on said pay-off mandrel

PARTICULAR DESCRIPTION OF THE DRAWING

One embodiment of this invention is shown in the accompanying drawing, of which the single FIGURE is a perspective view of an apparatus constructed in accordance with this invention.

In the drawing, a strip processing line shown generally at 10 includes a pay-off reel 12 powered by an electric motor 14 and having an expandable, horizontal, cantilevered pay-off mandrel 16. The pay-off mandrel is the type having two interlocking semi-cylinders of which the mutual contraction and expansion is controlled hydraulically. The pay-off reel 12 also includes a stripper bar 17 which is controlled hydraulically by two hydraulic cylinders 18. Mounted on the pay-off mandrel 16 is a coil 20 of steel strip 21. The coil 20 in the drawing is mounted on a sleeve 22, although this apparatus can also be utilized with coils which are not mounted on sleeves. The coil 20 shown on the drawing is analogous to the "A-coil" referred to at the beginning of this specification, and thus has a front-end portion of off-gauge thickness and a tail-end portion of off-gauge thickness.

To mount the coil 20 on the pay-off mandrel 16, a coil car 24 is utilized. The coil car runs on tracks 25 and has a hydraulically controlled cradle 26 which may be raised or lowered by the operator. The cradle 26 is V-shaped to accommodate a coil such as coil 20, and its height is controlled in such a way that the coil 20 can be run onto the pay-off mandrel 16 without interference. Naturally, during the fitting-on of the coil 20, the mechanism shown generally at 28 has been swung out of the way so as not to interfere with the movement of the coil 20 toward the pay-off mandrel 16.

Attention is now directed specifically to the mechanism shown at 28, which can be seen to include an arm member 30 which is mounted for pivotal movement about a fixed horizontal axis 31 which is spaced a given distance from the pay-off mandrel axis 32.

A transfer mandrel 34 is mounted on the arm member 30 for rotation about an axis 36 which is parallel to the fixed horizontal axis 31. The perpendicular distance between the axes 31 and 32 is the same as the perpendicular distance between the axes 31 and 36. The arm member 30 is shown in solid lines in a first position in which the mandrels 16 and 34 are aligned and in proximity. Thus, in the first position of the arm member 30 the axes 32 and 36 are colinear.

The arm member 30 is swingable between said first position shown in solid lines to a second position shown in broken lines in the drawing. Primed numbers are utilized in the drawing to show the second position. In the second position, the arm member 30' has been swung clockwise through an angle of about 120° from the first position, such that the transfer mandrel 34' is remote from the pay-off mandrel 16 and cannot interfere with the loading of a coil such as the coil 20. Mounted on the arm member 30 is a brake means 38 of a conventional nature, adapted to resist the rotation of the transfer mandrel 34 with respect to the arm member 30. The arm member 30 is adapted to rotate about a pin 40 journaled in a bearing member 42 supported on a base 43. A half-gear 44 is fixed with respect to the arm member 30, and a pinion gear 46 meshes with the half-gear 44. The pinion gear 46 is driven from a reversible gear-reduction box 48 which is powered by a motor 50. The mechanism just described is capable selectively of swinging the arm member 30 between the first position shown in solid lines and the second position shown in broken lines in the drawing.

A roll-out conveyor 52 having opposing pairs of rollers 53 in a V-configuration is positioned so as to be aligned with the transfer mandrel 34' in the second position shown in the drawing. A stripper bar 54 is controlled by hydraulic cylinders 56 (only one visible) and is adapted to strip tubular sleeves from the transfer mandrel 34' onto the roll-out conveyor 52. A tail-end scrap coiler 58 consists of a cart 60 adapted to roll along tracks 61, the cart 60 supporting the coiler motor 62, gear reduction means 64 and a scrap coiler mandrel 65 cantilevered horizontally from the gear reduction means 64. The scrap coiler mandrel 65 is the conventional split mandrel, as shown in the drawings. A fixed vertical plate 66 is anchored to the floor, and has a semi-circular cut-away portion 68 which is adapted to enclose part of the scrap coiler mandrel 65 with a slight clearance. Two hydraulic cylinders 70 are provided for moving the cart 60 toward and away from the fixed vertical plate 66. For this purpose, each hydraulic cylinder 70 has its one end fixed to the cart 60 at 71 and its other end fixed to the fixed vertical plate 66 at 72. Actuation of the cylinders 70 causes the cart 60 to move to the rear, thus causing the plate 66 to act as a stripper bar and remove the coiled scrap from the mandrel 65. A spot welding bar 74 carrying two spot welders is mounted on the cart 60 for pivotal movement toward and away from the scrap coiler mandrel 65.

A front-end scrap coiler 76 is located in the processing line and is adapted to wind up the front-end scrap from each A-coil which is fitted on the pay-off mandrel 16. The front-end scrap coiler 76 is essentially identical to the tail-end scrap coiler 58, and thus will not be described in detail. Most scrap coilers 58 and 76 have, in addition to the spot welding bar 74, a pressure roller 78 (not shown on scrap coiler 58 to avoid cluttering the drawing) which is resiliently biased toward the scrap coiler mandrel 65. Also, each scrap coiler has associated with it a scrap car 80 which runs on tracks 81 and is adapted to remove the coiled scrap when this is stripped from the scrap coiler mandrel 65. Between the front-end scrap coiler 76 and the pay-off reel 12 is a thickness-detecting gauge 82 through which the strip 21 is fed.

Having now described the essential components of the apparatus according to this invention, its operation will now be detailed.

OPERATION OF THE APPARATUS

In operation, the arm member 30 is first swung away from the first position (shown in solid lines) to a position in which it cannot interfere with the loading of an A-coil onto the pay-off mandrel 16. Preferably, the arm member is swung to the second position shown in broken lines in the drawing. Then, an A-coil is loaded onto the coil car 24 by conventional means, and the latter is run along the track 25 toward the pay-off mandrel 16 with the cradle 26 being properly adjusted vertically so that the A-coil runs smoothly onto the pay-off mandrel 16. During the loading of the pay-off mandrel 16, it is in its "collapsed" condition. The A-coil may or may not be wound on a tubular sleeve.

The pay-off mandrel 16 is then expanded to grip either the coiled strip or the tubular sleeve, whichever is the case, and the leading end of the strip is then fed through the thickness-detecting gauge 82 and over to the front-end scrap coiler mandrel 65 on the front-end scrap coiler 76. The leading end is inserted between the two halves of the split mandrel, and the front-end scrap coiler 76 begins to wind up the front end portion of off-gauge thickness, as the coil 20 rotates and pays out strip. The thickness-detecting gauge 82 registers the thickness of the strip as it passes through, and when the thickness is detected to be "on-gauge," this is a signal that all of the front end portion of off-gauge thickness has been wound onto the front-end scrap coiler 76, and the latter is shut down. An oblique cut is made through the strip 21 preferably between the gauge 82 and the front-end scrap coiler 76, and the new oblique leading end of the on-gauge portion of the A-coil 20 is led past the front-end scrap coiler 76 (i.e. it by-passes the scrap coiler 76) and is fed through the remaining portion of the processing line through a take-up mandrel (not shown) on which the on-gauge strip, after emerging from the processing line, is wound.

All of the on-gauge strip in the A-coil 20 is then run through the processing line until the gauge 82 announces that the tail-end portion of off-gauge thickness has begun to feed. At this point, the line is again shut down and the strip is again severed where its thickness is on-gauge. The mandrel 16 is then rotated backwards to wind the tail-end portion of off-gauge thickness again onto the coil, and what is now the leading end of the tail-end portion can then be tack-welded into place so that the tail-end portion does not spring apart.

The arm member 30 is then rotated from the second to the first position, the latter being shown in solid lines in the drawing, and the hydraulic cylinders 18 are then actuated to cause the stripper bar 17 to move outwardly and strip the tail-end portion (and its tubular sleeve if it is wound on one) from the pay-off mandrel 16 onto the transfer mandrel 34. The transfer mandrel has a plurality, preferably three, of friction bars 84 recessed longitudinally into its outer surface and resiliently biased outwardly, thereby permitting a frictional grip of the coiled scrap or the tubular sleeve as the latter is pushed by the stripper bar 17 onto the transfer mandrel 34. Once the scrap has been transferred to the transfer mandrel 34, the arm member 30

is swung from the first position to the second position, the latter being shown in broken lines, and while it is in this position, the transfer mandrel 34' is in juxtaposed relation with the scrap coiler mandrel 65. Throughout this specification and in the claims, the expression "in juxtaposed relation" will denote the relation shown in the drawing between the mandrel 65 of the tail-end scrap coiler 58 and the transfer mandrel 34' when the arm member is in the second position. In other words, this expression will denote a relation in which the two mandrels are parallel, are spaced from one another, and have their ends approximately lined up so that sheet material can be wound from one onto the other.

The next step of the process is to remove the tail-end portion from the transfer mandrel 34' by winding it onto the split mandrel 65 of the tail-end scrap coiler 58, while simultaneously loading a second A-coil into position on the pay-off mandrel 16 in the manner described above.

The second A-coil is dealt with in exactly the same manner as the first, except that after the first oblique cut to provide a leading edge for the portion of on-gauge thickness, this leading edge can be welded to the trailing edge of the on-gauge portion of the previous A-coil.

By continuing in this way, a composite B-coil which consists of the on-gauge portions of a number of A-coils, can be produced.

In the case where the original A-coil was wound on a tubular sleeve 22, the latter can be stripped from the transfer mandrel 34' in the second position after the tail-end scrap has been wound onto the scrap coiler 58, by actuating the hydraulic cylinders 56 to move the stripper bar 54 to the right. The tubular sleeve is thus kicked off onto the roll-out conveyor 52 along which it can move to a collection point.

What I claim is:

1. In a continuous strip processing line, apparatus for the rapid removal of tail-end coil scrap from a cantilevered horizontal pay-off mandrel including stripper means, the apparatus comprising:
 - an arm member mounted for pivotal movement about a fixed horizontal axis spaced a given distance from the pay-off mandrel axis and parallel therewith,
 - a transfer mandrel mounted on the arm member for rotation about an axis parallel to said fixed horizontal axis and spaced said given distance from said fixed horizontal axis, the arm member being swingable between a first position in which said transfer mandrel is coaxial with and in proximity to said pay-off mandrel and a second position in which the transfer mandrel is remote from said pay-off mandrel,
 - power means for selectively swinging the arm member between said first and second positions,
 - brake means for resisting the rotation of the transfer mandrel with respect to the arm member,
 - and scrap coiler means including a scrap coiler mandrel parallel and in juxtaposed relation to the transfer mandrel when the arm member is in said second position.
2. The invention claimed in claim 1, which further comprises sleeve stripping means located in a fixed

position so as to be in operating relation with the transfer mandrel when the arm member is in said second position, such that a sleeve on the transfer mandrel in said second position can be stripped therefrom after the coil scrap has been removed from the sleeve onto the scrap coiler means.

3. The invention claimed in claim 2, which further comprises a roll-out conveyor aligned with the transfer mandrel when said arm member is in said second position, such that sleeves stripped from said transfer mandrel can be removed.

4. The invention claimed in claim 1, which further comprises a car for the removal of coiled scrap from the scrap coiler means, and the scrap stripping means cooperating with said scrap coiler means to strip the coiled scrap from the scrap coiler means onto said car.

5. The invention claimed in claim 1, in which the transfer mandrel has a plurality of friction bars recessed longitudinally into its outer surface and resiliently biased outwardly, thereby permitting a frictional grip of the coil scrap.

6. In a continuous strip processing line which includes a pay-off reel having a cantilevered horizontal pay-off mandrel including stripper means, a method of changing coils of strip each of which has a front-end and a tail-end portion of an off-gauge thickness, said method comprising the steps:

- providing an arm member mounted for pivotal movement about a fixed horizontal axis spaced a given distance from the pay-off mandrel axis and parallel therewith, a transfer mandrel mounted on said arm member for rotation about an axis parallel to said fixed horizontal axis and spaced said given distance from said fixed horizontal axis, the arm member being swingable between a first position in which said transfer mandrel is coaxial with and in proximity to said pay-off mandrel and a second position in which the transfer mandrel is remote from said pay-off mandrel,
- swinging said arm member away from said first position,
- placing a first coil in position on said pay-off mandrel,
- winding the front-end portion of the first coil onto a scrap coiler in the processing line,
- halting the movement of the strip,
- severing the strip where its thickness is on-gauge,
- running the strip through the processing line until the tail-end portion of off-gauge thickness begins to feed from the coil,
- halting the movement of the strip,
- severing the strip where its thickness is on-gauge,
- stripping the coiled tail-end portion from the pay-off mandrel onto the transfer mandrel with the arm member in said first position,
- swinging the arm member to said second position,
- and removing said tail-end portion from the transfer mandrel while simultaneously placing a second coil in position on said pay-off mandrel.

7. The method claimed in claim 6, in which the step of removing said tail-end portion from the transfer mandrel is accomplished by winding the tail-end portion onto a scrap coiler having a scrap coiler mandrel in juxtaposed relation to the transfer mandrel.

8. The method claimed in claim 6, in which all coils of strip are wound on re-usable sleeves, and in which the step of removing said tail-end portion from the transfer mandrel is followed by the step of stripping the remaining sleeve from said transfer mandrel while the arm member is in said second position. 5

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