

Jan. 8, 1946.

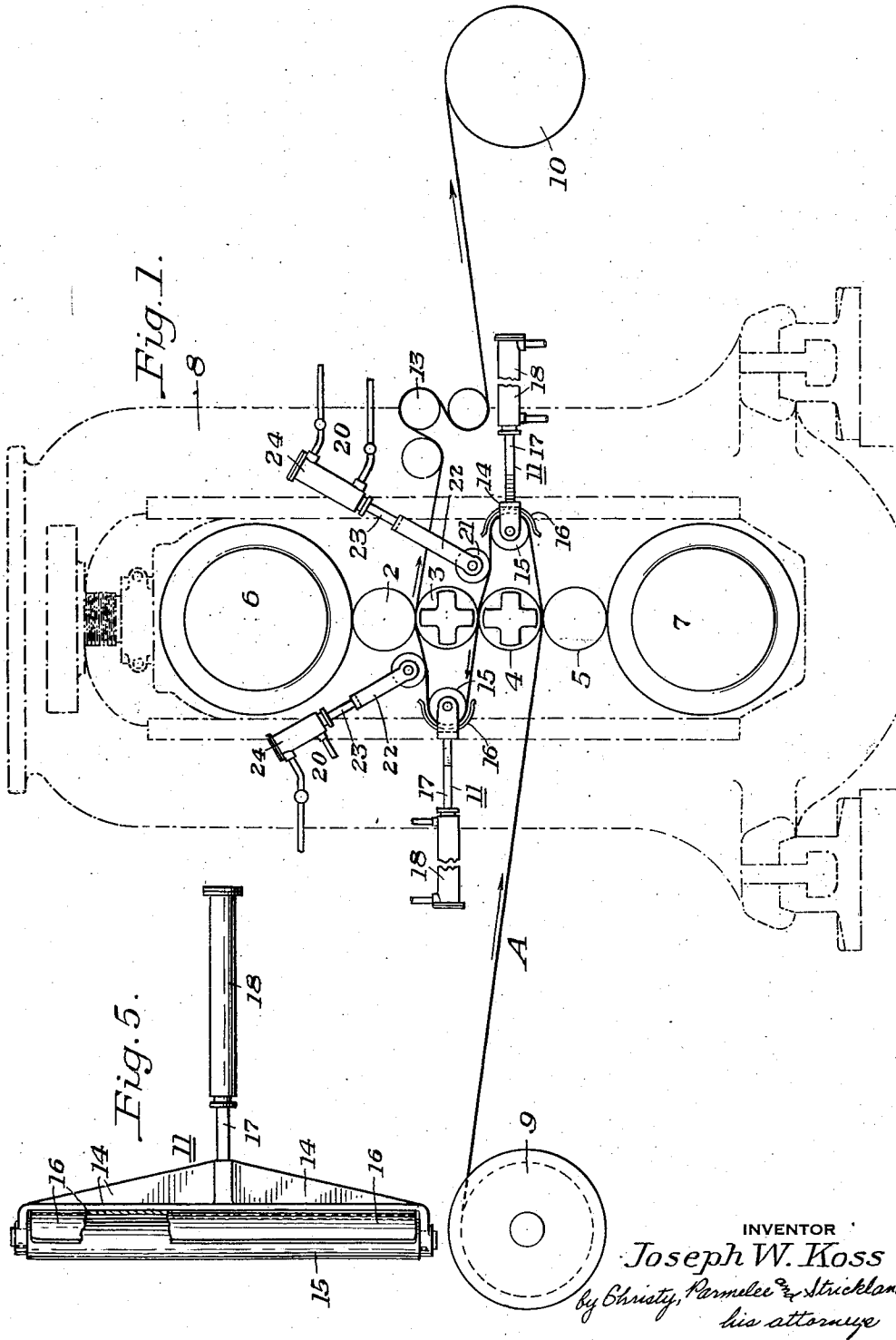
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2,392,323

ROLLING STRIP METAL

Filed Dec. 20, 1941

2 Sheets-Sheet 1



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Fig. 2.

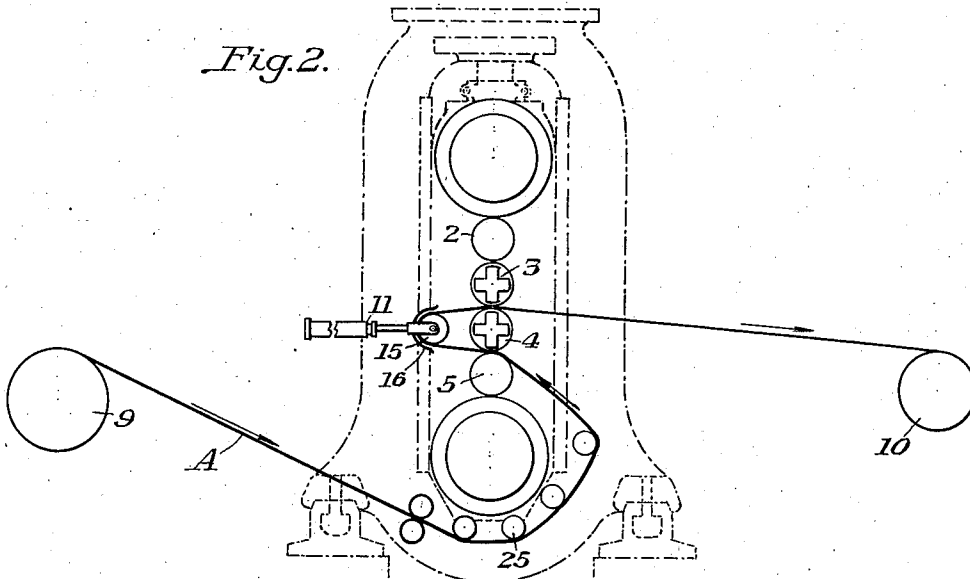


Fig. 3.

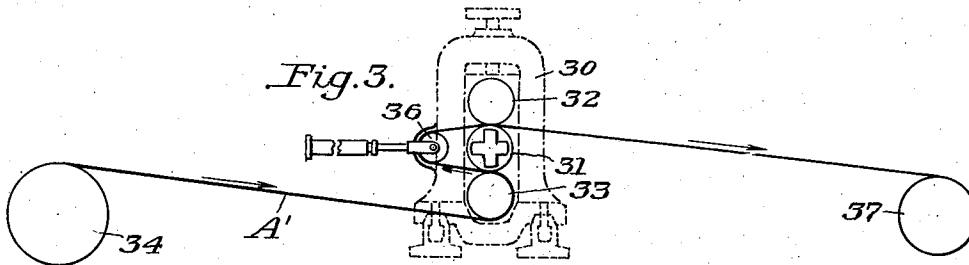
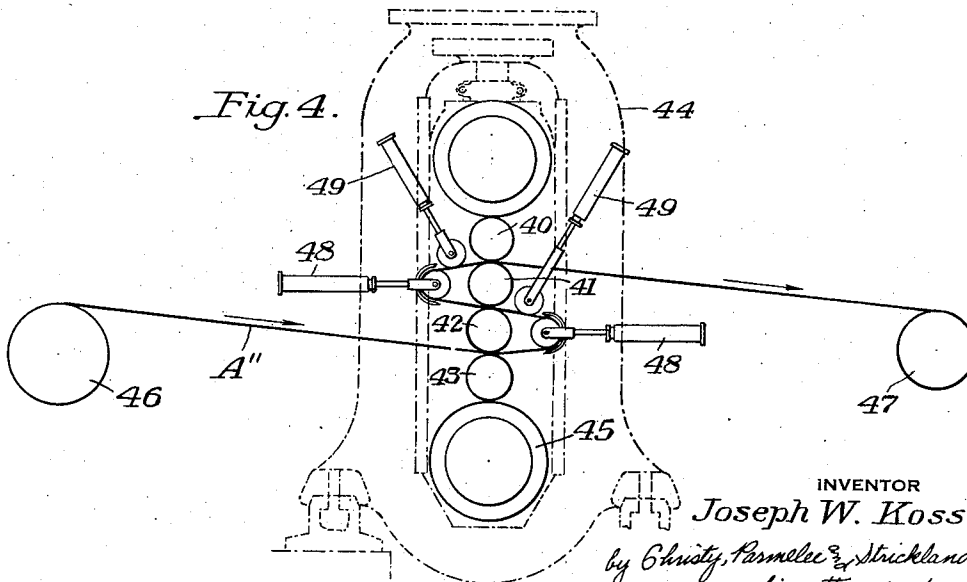


Fig. 4.



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ROLLING STRIP METAL

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12 Claims. (Cl. 80—32)

This invention relates to the art of rolling metal and is for a method and apparatus for cold rolling so-called continuous strip or sheet metal.

In the rolling of strip or sheet metal, particularly ferrous metal, the final rolling operation is performed for the purpose of imparting certain physical characteristics to the metal. This is usually referred to as temper rolling or sometimes as skin rolling. The object is to pass the metal between work rolls, the effect of which is to elongate the metal only slightly and to affect its thickness very slightly. This cold working however, does develop the desired temper in the metal to suit it for the purpose for which it is to be used.

The amount of work which has to be done may vary considerably depending upon the nature of the metal and the quality of the product to be made. Most frequently two and often three or more passes are required to properly flatten and temper strip steel which has been rolled and then annealed to dead softness to enable it to be used for ordinary purposes, such as the making of tin can stock or for similar purposes.

The most common practice is to run the strip material two or more times through a single stand mill, the material from the take up reel being transferred after one pass through the mill around to the unwinding station and repassed through the same mill. In some instances a single high reversing mill may be used. Another common practice is to have two or more stands of rolls arranged in succession so that the continuous strip material is progressively engaged in the roll passes of the several stands of rolls in a single rolling operation. If three temper passes are required, the mill is provided with three stands of rolls arranged in succession.

According to the present invention temper rolling is accomplished by the use of a single stand mill having a multiple of work rolls so arranged as to provide a plurality of roll passes one above the other in the single multiple high stand. The strip material is threaded through the mill so as to pass between one pair of rolls in one direction and between another pass in the opposite direction and if desired, through a still further pass in the same direction as the first. Thus, a single multiple high mill is employed to simultaneously provide a number of temper rolling passes. Provision is made for maintaining the material under tension in all of the passes and additional cold working of the material is provided by the fact that the direction of travel of the material is reversed one or more times in

passing through the mill, although the mill itself operates continuously in one direction.

The invention saves considerable time over the usual method employing a single stand mill because all of the temper passes take place simultaneously and the strip material does not have to be passed first through the mill and wound into a coil, then transferred to the opposite side of the mill and repassed one or more times through the mill, and it also saves time as compared with a reversing mill. In this respect, the invention provides all the advantages of a multiple stand mill. However, the present invention requires no more floor space than the usual single stand mill because only a single roll stand is necessary, and in addition to the saving of floor space it is much cheaper to construct and substantially cheaper to operate than a multiple stand mill which provides the same number of passes. Not only does the invention provide the advantages of both single stand and multiple stand mills, but a further advantage results over both of these types of mills due to the cold working which is imparted to the metal upon being turned upon itself to travel first in one direction and then in the other.

The invention may be more fully understood by reference to the accompanying drawings which more or less schematically illustrate the invention and from which the method will appear. In the drawings:

Figure 1 is a side elevation of a mill embodying my invention, various unessential parts of the mill being omitted and the housing, for the purpose of clearly showing the invention being illustrated in dot-and-dash lines;

Figure 2 is a view similar to Figure 1 but on a smaller scale, showing an arrangement which may be employed on the mill of Figure 1;

Figure 3 is a view similar to Figure 2, showing a 3-high mill with only one driven roll;

Figure 4 is a view similar to Figure 3, showing a 6-high mill with no rolls driven.

Figure 5 is a detailed plan view showing one form of looper or tensioning means which may be used with the mill.

Referring first to Figure 1, there is illustrated a multiple high mill having four work rolls, designated 2, 3, 4 and 5. The work rolls 3 and 4 are arranged to be power driven and to indicate this the driving connection at the end of the roll necks has been conventionally illustrated. The rolls 2 and 5 are illustrated as being of the same diameter as the rolls 3 and 4 but they might be of a different diameter. Above the uppermost work

roll 2 is a backup roll 6 and below the work roll 5 is a backup roll 7. The roll housing, designated generally as 8, may be of any conventional form used in multiple high mills of this character.

At one side of the roll stand is a feeding station having a feed reel 9. At the other side of the mill is a takeup station having a winding or take-up reel 10. The feed and takeup reels 9 and 10 respectively, are of any usual or preferred construction, the feed reel if necessary being provided with a brake as is the usual practice to maintain a tension on the strip being delivered to the mill while the takeup reel 10 may also be driven at such a rate with respect to the work rolls 3 and 4 as to maintain a tension on the strip. The strip material, designated generally as A, is fed from the feed reel 9 into the pass between the rolls 4 and 5. It is then looped by means of a looper or tension means, designated generally as 11 and passes back through the mill between the rolls 3 and 4. It passes around a second looper 11 and is engaged in the pass between the rolls 2 and 3. From here it is delivered to the takeup reel. A cluster of tensioning rolls 13 of conventional form may be located between the last pass of the mill and the take-up reel 10.

A preferred form of looper or tensioning means comprises a reciprocable frame or support 14 in the end of which is mounted a roller 15. Carried on the frame 14 back of the roller 15 is a curved metal plate 16. The support 14 is carried at the end of a piston rod 17 and at 18 is a fluid pressure cylinder, by means of which the support 14 may be moved toward and away from the work roll with which the looper cooperates.

In the operation of the mill the rolls 15 of the looping device are initially positioned close to the work rolls opposite which they are positioned. The curved guide plate 16 has a span such that when the end of the material emerges from the pass between the rolls 4 and 5 for example, it travels under the roller 15 and is curved by the plate 16 around the periphery of this roller and into the pass between the rolls 3 and 4. The other looper functions in a similar manner. As soon as the material has been threaded through the mill, pressure is applied to the cylinders 18 tending to move the rollers 15 away from the work rolls with which they cooperate. This pressure is adjusted to the tension which it is desired to maintain on the material. Since the material elongates very slightly in passing between the rolls 4 and 5, tending to form a loop in the strip material, the roll 15 will be drawn back away from the work roll as the loop develops, keeping the strip material taut and under the necessary tension.

In addition to the tensioning devices, hold-down devices may be used to keep the material tight when the trailing end of the strip is passing through the mill. Two of these hold-down devices are shown. Each of them is designated 20. Each hold-down device is shown as having a roller 21 adapted to ride on the strip material. This roller is supported at each end in the arms of a yoke 22 that is pressed down by a piston 23 in a fluid pressure cylinder 24, the yoke straddling the strip material. When the trailing end of the material clears the pass between the work rolls 4 and 5 this loop in the strip will slacken. The pressure in the cylinder 24 will immediately force the roller 21 down so that the material constituting the loop will be pressed against the surface of the roll 4 and will travel between the roll 21 and the roll 4. In like manner the hold-down device

20 on the left-hand side of the mill as viewed in Figure 1 restrains the trailing end of the material after the material clears the pass between the work rolls 3 and 4.

In the operation of the mill the screw-down devices at the top of the mill are adjusted to maintain proper pressure in the roll passes. As previously indicated, this pressure is sufficient to work the metal in the strip with very little reduction in gauge and consequently very little elongation. It is sufficient, however that with a number of passes the desired temper or other qualities imparted by cold working are acquired by the strip. Because of the presence of the tensioning devices at each side of the mill, the elongation which does occur is taken care of and the material is nevertheless kept under the desired degree of tension. Not only does the mill temper the strip but it flattens it as is required of mills of this character. In addition to the working which is accomplished in the roll passes the cold bending of the material around the looping rolls 15 gives additional working of the metal so that the degree of cold working accomplished in three passes of the material through this mill may actually be greater than that which would be acquired in passing the material through a succession of single roll passes. Since the work rolls 3 and 4 are both driven they must be of uniform diameter in order to rotate at the same speed.

Sometimes in the cold working of metal for temper rolling it is desirable that the surface of the material be roughened in one or more of the roll passes so as to increase the degree of cold working imparted to the individual areas of the metal. This may be provided for in the present mill by roughening in the conventional manner the surface of the work rolls 4 and 5. A smooth pass would then be provided between the work rolls 2 and 3. If only one surface of the metal is to be rough then one roll as for example 4 or 5 may have a rough surface. Moreover, by proper arrangement of the roll surfaces, various finishes on the material can be secured. For example, by having two smooth faced work rolls and two dull or rough work rolls, a bright smooth finish may be secured in a single pass through the two smooth rolls; or a dull finish may be secured by a single pass between the two dull rolls; or a semi-bright finish can be secured using three passes. Also, by having three smooth work rolls and one rough or dull finish roll, one can selectively have one side bright and one dull, or one side bright and one semi-dull or both sides bright and smooth. The various commercial finishes heretofore obtainable only in multiple stand mills or in single stand mills with intervening roll changes may be selectively produced in this single stand mill without in most cases, any roll change.

It will of course be understood that the direction in which the material travels back and forth through the mill is not important. Instead of the metal entering the lowermost pass between the rolls 4 and 5, the direction may obviously be changed so that it first enters the uppermost pass between the rolls 2 and 3.

Under some circumstances it may be desirable to so construct the multiple high mill that the metal can be given one, two or three passes, according to the requirements of the particular metal being rolled. When this is to be done the arrangement illustrated in Figure 2 may be employed. In Figure 2 the mill is essentially the same as that shown in Figure 1 and similar reference numerals have been used. However, in

addition to several work rolls described, a series of small guide rolls designated generally as 25 may be mounted in the lower part of the roll housing. In this case the material may pass from the feed reel 9 to the takeup reel 10 in any one of several ways. It may be passed through the mill once, going between the work rolls 3 and 4 for a single pass. It may be guided around the rollers 25 and then passed between the rollers 4 and 5 and repassed through the rollers 3 and 4. With three passes the mill would be operated as shown in Figure 1. In the arrangement shown in Figure 2 the various hold-down and looping devices have not been shown, except that one looper is illustrated.

In the modification shown in Figure 3 the metal is also given a plurality of passes in a multiple high mill. In Figure 3 the mill, designated generally as 30, is a 3-high mill in which only the center roll designated 31 is driven, while the upper roll 32 and the lower roll 33 are not driven. The rolls 31, 32 and 33 are illustrated as being of relatively larger diameter than the work rolls of Figures 1 and 2, merely to illustrate that the invention is not confined to a multiple high mill having both working and backup rolls, but the invention may be practiced and embodied in any multiple high mill having suitable work rolls arranged to provide more than a single pass.

In Figure 3 the material, designated A' is fed from the feed reel 34 around the lower work roll 33, passes between the work rolls 31 and 33, then passes around a looping or tensioning device 36 and repasses between the work rolls 31 and 32 and from there goes to the takeup reel 37. The looping device 36 is similar to the device 11 previously described. Hold-down devices similar to the hold-down device 20 of Figure 1 may be used, one to cooperate with the roll 33 and one to cooperate with the roll 31, although these have not been shown.

In the arrangement shown in Figure 4 none of the rolls is driven and the material is pulled through the mill under tension. This view illustrates a multiple high mill similar to that shown in Figure 1, with four work rolls 40, 41, 42 and 43. Backup rolls are shown at 44 and 45. The feed reel is designated 46 and the takeup reel is designated 47. In this case all of the power required for rolling is applied to the takeup reel 47. The feed reel 46 may be provided with a brake as is customary in the art. The material A'' is illustrated as passing first between the rolls 42 and 43 and then between rolls 40 and 41. Looping and hold-down devices, designated 48 and 49 respectively, may be similar to those previously described.

The method accomplished by the apparatus shown in Figure 4, like the method in Figure 1, causes the material to be kept under tension between the successive roll passes. Additional cold working is provided by the fact that the material is folded back and forth as it passes, repasses and emerges from the mill.

As hereinabove indicated, the mill of the present invention requires no more floor space than a conventional single stand or reversing mill and is only very slightly more expensive to construct. At the same time each single roll stand gives the time saving advantage and choice of surface finishes of a multiple stand mill at a tremendously less cost for floor space, equipment, and maintenance.

While I have illustrated and described certain specific embodiments of my invention and specific

mills for carrying out the method, it will be understood that this is merely by way of illustration and that various changes and modifications may be made within the contemplation of my invention and under the scope of the following claims.

I claim:

1. In the temper rolling of strip metal, the steps which comprise simultaneously passing the strip metal between a plurality of passes in a single multiple high mill, turning the strip over between the successive roll passes, and exerting tension to pull the loop of material between successive roll passes away from the mill to compensate for elongation and maintain tension on the material between the successive roll passes.

2. In the temper rolling of strip metal, the steps which comprise simultaneously passing the strip between a plurality of rolling passes in the same roll stand, bending the strip from its point of emergence in one pass to its point of entry in the next pass, and moving the point of bending away from the roll stand as the loop between passes elongates to keep controlled tension on the strip as it is being bent.

3. A multiple high rolling mill having at least three work rolls, means for guiding a strip from a pass between two of the work rolls to another pass between two work rolls, whereby the material receives at least two passes in the same roll stand, and means apart from the mill cooperating with the strip for maintaining tension on the material in all of the passes.

4. A multiple high mill having at least three work rolls providing a plurality of roll passes in a single roll stand, whereby strip material may be looped to travel first through one pass and then through another, tensioning means about which the material travels from one pass to the next for maintaining tension on the material, and means in addition to the tensioning means for holding down the trailing ends of the strips between the successive passes.

5. A multiple high rolling mill having at least three work rolls superimposed in cooperating relation, means for guiding strip material from a pass between two work rolls to another pass between two work rolls whereby the material simultaneously receives at least two passes in the same roll stand, means other than the rolls for maintaining the loop of material where it emerges from the first roll pass and enters the second under tension, and means for maintaining tension on the trailing end of the material after such loop has been opened.

6. A multiple high rolling mill having at least four superimposed work rolls, means for confining strip material to an S-shaped travel through the mill, whereby the same strip simultaneously moves through the three passes provided by the four work rolls, and tensioning means in each loop of the S-shaped travel for taking up slack resulting from the elongation of the strip.

7. In the temper rolling of strip metal, the steps which comprise passing the strip from a feeding station through a plurality of passes in a single multiple high mill to a takeup station and in the travel of the strip between successive passes, applying tension to the strip and turning it over under tension.

8. A multiple high mill having at least three work rolls providing a plurality of roll passes in a single roll stand, whereby strip material may be looped to travel first through one pass and then through another, means for feeding strip material to the mill, means for taking up strip

material from the mill, and means effective upon the strip material in its passage between said passes for applying tension upon the material.

9. A multiple high rolling mill having at least three work rolls forming at least two successive passes for the rolling of strip material, with the material looped outward from the rolls in the interval between the successive passes, means engaging the loop for guiding the strip between the passes, and means cooperating with said last means for maintaining controlled tension on the material in the loop while it is being rolled, and supply and take-up stations for the strip material being rolled.

10. In the temper rolling of strip metal, the steps which comprise passing the strip from a feeding station through a plurality of passes in the same roll stand to a takeup station, establishing outward from the passes a loop in the strip advancing between two of said passes, effecting in said loop compensation for elongation of the advancing strip and maintaining controlled tension thereon.

11. The method of operating a multiple high mill having at least three work rolls forming at least two successive passes to effect the temper rolling of strip material, which comprises passing the strip material from a feeding station through said passes of the mill to a takeup station and in the travel of the strip material between said passes forming outward from the passes a loop in the strip material and controllably applying tension thereon.

12. The method of operating a multiple high mill having at least three work rolls forming at least two roll passes to effect the temper rolling of strip material, which comprises passing the strip material from a supply station successively through said passes to a takeup station, and in the travel between said passes forming a loop in the strip material outward from the rolls and maintaining a controllable tension on the material constituting the loop and additionally applying tension in the material between the mill and the take-up station.

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