April 4, 1944. J. LA MARCA 2,345,756

HANDLING STRIP MATERIAL

Filed Feb. 2, 1940

Fig. 1.

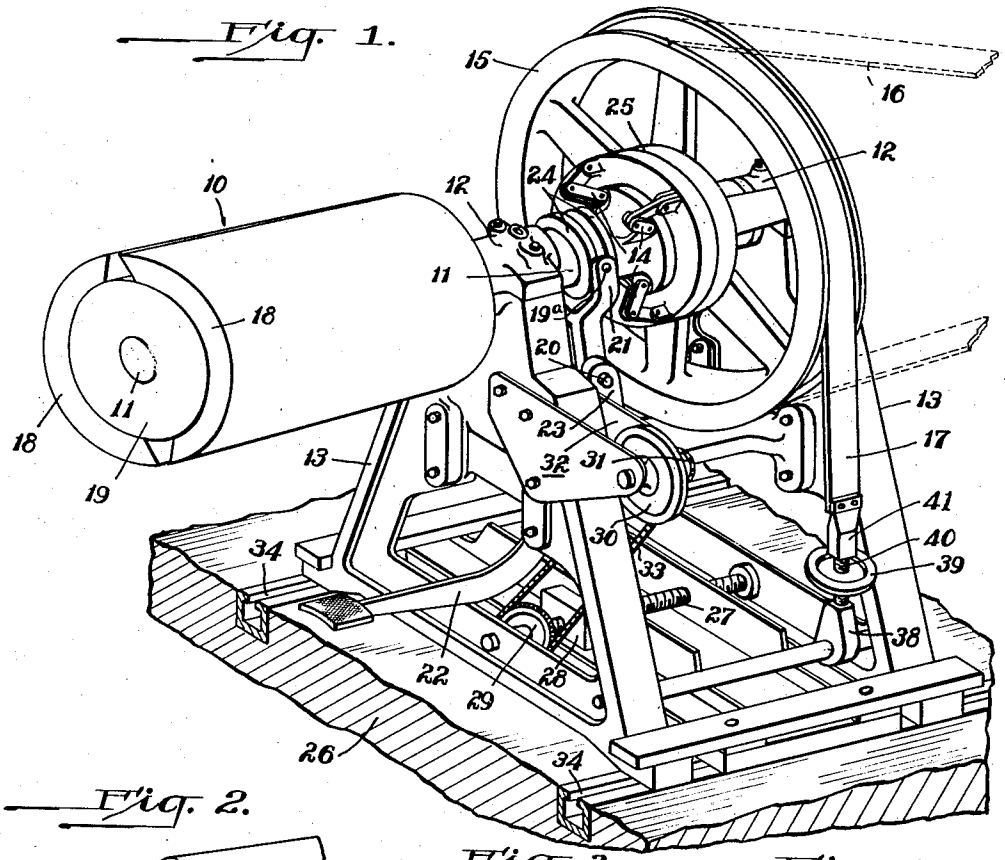


Fig. 2.

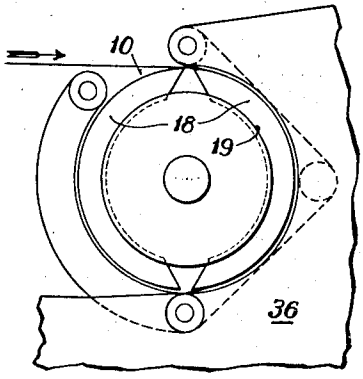


Fig. 3.

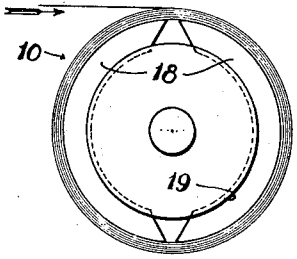


Fig. 4.

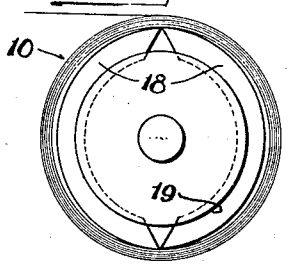
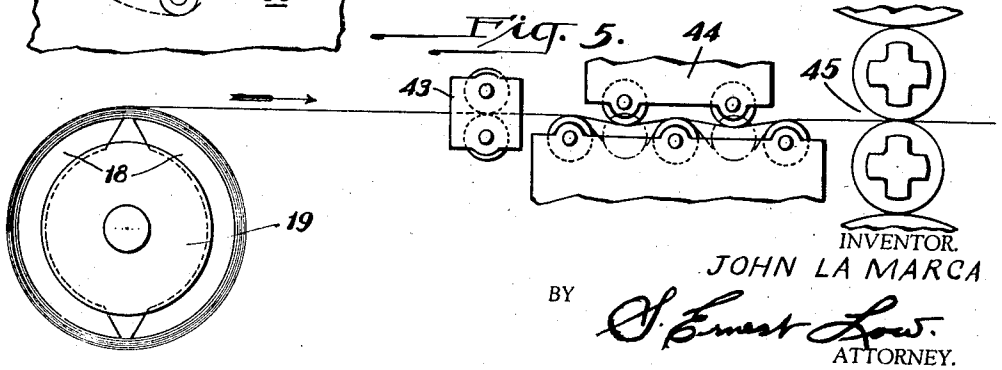


Fig. 5.



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HANDLING STRIP MATERIAL

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6 Claims. (Cl. 80—60)

This invention relates in general to handling, treating, and delivering coiled strip material as may apply in further working or processing operations.

Particularly, the invention contemplates the steps of coiling strip material, and delivering the strip material from a coil to a rolling mill or other working or processing device, with or without the intermediate step of oil spraying or dipping, pickling, washing, annealing, or otherwise treating the coiled strip material. The invention more particularly contemplates maintaining tension in the strip material as it is delivered to a rolling mill or other working or processing mechanism.

The invention has for one of its objects the delivery of strip material to a working or processing device, under tension, from a coil of the strip material which is frictionally held or supported on an expansible unwind reel.

Another object of the invention is the elimination of the use of spools, sleeves, cores, or the like, upon and from which strip material is customarily coiled and uncoiled in successive working or processing operations, and which would normally remain within the coils of strip material as they are transported or otherwise handled or treated.

A further object of the invention is the handling of strip material in coiled form for the treating of the same in any number of fabricating operations, such as in oil spraying or dipping, pickling, washing, annealing, and the like, without the use of spools, sleeves, cores, and the like, and without necessitating the winding of the strip material onto a spool, sleeve, core, or the like, to prepare it for delivery to a working or processing mechanism.

Other objects, to which the invention readily lends itself either singly or in combination, are the formation of strip material in coiled form with or without the aid of a winding reel or mandrel; the removal of a coil of material from a winding reel or mandrel axially, when one is used, rather than by unwinding the material; the transportation and handling of a coil of material without the burden or inconvenience of a spool, sleeve, core, or like dead weight or mass; the thermal treatment of a coil of material without losses arising out of heating a spool, sleeve, core, or the like, when such operation is performed; the charging or placing of a coil of material on an unwinding reel or mandrel axially, for delivery of the material in strip form therefrom, rather than by a winding or rewinding operation; and the placing or charging of a strip of material under tension as it is further worked or processed, through resisting rotation of an unwinding reel or mandrel supporting a coil of said material.

The method of the invention is capable of performance with, and lends itself readily to, various types of expansible-contractible unwinding and rewinding reels or mandrels. One dual form of such apparatus for winding and unwinding strip material is illustrated in the drawing appended hereto, which likewise illustrates various stages of the operation of such a mechanism.

In the drawing:

Fig. 1 represents a perspective view of an expansible-contractible reel and its associated apparatus;

Fig. 2 represents a side or end view of such a reel in expanded condition as used to wind strip material, and having associated therewith a wrapping device, the strip material being preliminarily wrapped on the reel;

Fig. 3 represents a side or end view of the same reel as is illustrated in Fig. 2 and in expanded condition, the wrapping device having been retracted and therefore not illustrated, this view showing the strip material at a later period in its process of winding;

Fig. 4 represents a side or end view of the reel illustrated in Figs. 1 through 3 in collapsed condition with a coil of strip material supported thereon; and

Fig. 5 represents a side or end view of the aforementioned reel in expanded condition in its association with feed rolls, a bridle, and a rolling mill, as used to unwind and deliver strip thereto, the coil of strip material being held on the reel and a length of the same passing through the feed rolls, bridle, and mill in the preformance of a strip working operation.

In the following description of the method of this invention, it will be understood that various forms of apparatus associated with the fabrication of strip material may be employed. Since the invention is particularly concerned with handling, treating, or processing, and delivering strip material from coils in its association with other well-known fabricating processes, an apparatus for and method of forming coiled strip material has been particularly illustrated in Figs. 1 through 4.

Referring to the accompanying drawing, Fig. 1 illustrates a preferred form of apparatus adapted for winding strip material. It comprises an expansible-contractible reel 10 secured to a

suitable shaft 11 journalled in bearings 12 of a main frame 13. The reel 10 is supported in cantilever manner and is adapted to have strip material wound thereon (or unwound therefrom) and to have a coil of strip material removed therefrom (or placed thereover) axially. For imparting rotation to the reel 10, its shaft 11 is provided with a pulley 15 adapted to be driven by a belt 16 (shown in dotted lines). The apparatus, when used for unwinding, is provided with a brake band 17 (shown in full lines) which is removable to accommodate the aforementioned belt 16 during a winding operation. The purpose of brake band 17 will be explained hereinafter. Pulley wheel 15 is suitably driven through belt 16 by means of any suitable prime mover such as an electric motor or the like.

The expansible-contractible reel 10 is composed of two segments 18 assembled for movement toward and away from each other by any suitable mechanism within the interior of reel 10 behind the end cover plate 19. The segments 18 have cylindrical external contour, the arcs thereof falling slightly short of 180°. From this, it will be understood that, in coil-gripping expanded condition, the reel 10 will present a true cylindrical outer contour, segments 18 being separated or spaced slightly adjacent their ends. This separation or spaced relationship of segments 18 permits their movement toward each other to a coil-releasing contracted condition, in which condition the reel presents an oval-shaped outer contour.

The mechanism for expanding and contracting segments 18 of reel 10 comprises suitable camming means of conventional design mounted within the interior of the reel. In a preferred construction of collapsible reel, the camming means are operated by axial movement of a rod located within the aforementioned shaft 11. For this purpose, shaft 11 is preferably made hollow, and the rod (not shown) within the shaft 11 is provided with laterally extending pins 19a which project through suitable slots in the wall of hollow shaft 11. A foot pedal 22, which is bifurcated or otherwise provided with a yoke 21, is attached to or suitably connected with the pins 19a, foot pedal 22 being otherwise pivoted at 20 to the main frame 13 through the medium of a pin in bearings 23. It will be understood from this construction that depression of foot pedal 22 will axially shift the rod within shaft 11 to cause reel 10 to expand.

A further instrumentality associated with the bifurcated end or yoke 21 of foot pedal 22 is provided in the form of a collar 24 slidable upon the exterior of shaft 11. The collar 24 is interconnected by suitable linkage 14 with a clutch 25 for connecting pulley wheel 15 and shaft 11 simultaneously with the expansion of reel 10. Since clutch 25 is not essential to the operation of the reel 10 if suitable control of the prime mover is available, its details need not be further enlarged upon herein.

For laterally aligning reel 10 and the strip material forming the coil thereon with respect to the rolling mill or other working or processing device from which the strip material is delivered, means have been provided for adjustably locating frame 13 with reference to its foundation 26. This particular means comprises a screw threaded rod 27 journalled and secured against axial movement at its ends in the base portion of frame 13, and a fixed nut 28 in engagement with rod 27 and secured to the foundation 26. The rod 27 is provided with a toothed sprocket 29 secured thereto, a hand wheel 30 and sprocket 31, chain connected by means of a chain 33 with sprocket 29, being journalled in a suitable bracket 32 secured to an upper portion of frame 13. Rotation of hand wheel 30 serves to rotate rod 27 within nut 28 to effect relative movement between the frame 13, together with its associated parts, and foundation 26, suitable ways 34 serving as guides for such relative movement.

In the adaption of the mechanism of Fig. 1 in the performance of the preliminary method steps of this invention, strip material coming from a rolling mill or the like is coiled upon the reel 10 by wrapping one turn thereof on another as is well-known in the art. For aiding in a wrapping operation, the conventional belt wrapper 36, shown in Fig. 2, is preferably employed, although other suitable means may be used. Tension in the material being wound or coiled, as illustrated in Fig. 3, is adjusted by controlling suitable speed and power adjusting means associated with the prime mover, or by controlling the amount of slip in the aforediscussed clutch 25. During a strip winding operation, foot pedal or treadle 22 is depressed to engage clutch 25 and retain the winding reel 10 in expanded condition. The coil is axially removed at the end of a winding operation by releasing the foot pedal 22, disconnecting clutch 25, and contracting reel 10, the contracted condition of reel 10 being clearly illustrated in Fig. 4.

When it is desired to coil material without appreciable coiling tension, the well-known three-roll coiler may be employed. In such case it is preferable and usually desirable to control the bending or curvature imparted to the strip material so as to produce a tightly wound coil. This may be effected by imparting greater curvature to successive coil layers than is normally necessary to merely wind a closed coil, as distinguished from a tightly wound or wrapped coil. Such procedure, which may be effected by controlling one of the rolls of a three-roll coiler, will produce a tightly wound coil approximating one wound or coiled under tension. Other methods of producing coils of strip material will be recognized by those skilled in this art.

It is considered preferable, however, to wind coils under tension, as first described, not only to improve rolling, working or processing characteristics imparted by the working device preceding the winding reel, but also to better prepare the coil of material for succeeding rolling, working or processing under unwinding tension, as will hereinafter appear.

A coil removed axially from the winding reel after contracting the reel is subsequently transported, and possibly annealed, or otherwise thermally treated, washed, pickled, oil sprayed or dipped, or the like, without the inconvenience and waste of handling the material together with a supporting spool, sleeve, core, or the like, within the coiled material. The invention, then, greatly facilitates handling as above described subsequent to a winding operation. Thereafter the coil is ready for unwinding and delivery to a subsequent rolling mill or other working or processing device or treatment.

A succeeding apparatus advantageously employed with this invention is the unwinding reel likewise represented by Fig. 1, along with Figs. 4 and 5.

In Fig. 1 the preferred form of unwinding ap-

paratus is also illustrated. It comprises substantially the same elements as the winding apparatus previously described, including the same reel 10, shaft 11 journalled in bearings 12 of main frame 13, and pulley 15 (here serving as a brake).

In the case of unwinding a coil of strip material, pulley wheel 15 is to be resisted in its rotation to retard or act against the rotation of reel 10 and its supported coil of strip material. For this purpose the drive belt 16 (shown in dotted lines) is removed and in its place a suitable brake band 17 (shown in full lines) is placed over pulley 15 to serve as a Prony type brake. Brake band 17 is suitably secured at one of its ends to the rear of frame 13, and is adjustably secured at its other end to an opposite corner of frame 13, as at anchor nut 38. Hand wheel 39 is provided and is adapted to turn a threaded rod 40 to take up belt 17 by drawing anchor nut 38 and a nut 41 secured to the end of brake band 17.

The remaining elements of the apparatus, as used in the performance of an unwinding or uncoiling operation, include the aforementioned segments 18, cover plate 19 at the end of reel 10, pins 20 by means of which the bifurcated end or yoke 21 of foot pedal 22 is pivoted in bearings 23, collar 24 connecting to clutch 25 (here serving as a brake clutch), and foundation 26, frame 13 being movable through threaded nut 27, fixed nut 28, sprockets 29 and 31, hand wheel 30, chain 33, and the ways 34.

When it is desired to unwind strip material from a coil thereof in the later method steps of the invention, the coil is transported to a position adjacent roll 10 and is then axially charged upon reel 10. Segments 18 are thereafter expanded under pressure of foot pedal 22 to engage the inner turn of strip material over its full inner surface while maintaining the true cylindrical form of the coil.

Exemplary of the practice of this invention in the performance of an unwinding operation, strip material is manually or mechanically fed from the reel 10 to a mill 45 (Fig. 5) or other working or processing device. In Fig. 5 feed or pinch rolls 43 are shown which aid in guiding, feeding, or tensioning the strip material. A bridle 44 may also be employed between rolls 43 and the mill 45 for causing the strip material to follow a tortuous path to place additional tension in the material.

The method of the invention, in its practice of delivering strip material from a coil to a rolling mill or the like includes, after placing a coil of material over the reel 10 and expanding the reel, the threading of the strip material to the rolls of the mill, preferably through pinch rolls 43 and bridle 44. The method further includes placing the material in tension by resisting rotation of reel 10, and also, preferably, by intermeshing the rolls of bridle 44 to cause the strip material to follow a tortuous path. While in some instances the normal resistance to rotation of reel 10 may be sufficient, the combined use of brake band 17 and bridle 44 is preferred in order to induce appreciably high values of total tension. In order not to scratch or over-tighten the coil of strip material, tension should not be appreciably above that under which the coil was originally wound by the winding means.

From the foregoing description of the invention, it will now be understood that the method described herein requires a self-supporting coil of strip material. In order to produce a coil by winding upon a reel or mandrel, or by coiling with a three-roll coiler, which will be self-supporting, it is essential to wind the material under tension, or to coil the same under controlled bending or curvature. The term "self-supporting" coil of strip material, as herein used, defines a coil which will substantially retain its relative shape and arrangement of layers of strip material following its release from a contractible winding reel or ejection from a coiler, and which coil may be engaged by an expansible unwinding reel without appreciable change in shape.

A coil is self-supporting, then, when there is no appreciable loosening of the superimposed layers or wraps of the same when it is released from a mechanism which has wound or coiled the same, or when it is subjected to the expanding pressure of an expansible unwinding reel. Such characteristic may be caused either by the elasticity or springiness of the strip material or by the resistance of superimposed layers of material to relative sliding. The self-sustaining or self-supporting characteristic of a coil may be imparted thereto by tension winding a number of turns of the material, or by coiling a number of turns under controlled bending, as described herein. Lightness of gauge of the strip material may be offset by a sufficient number of turns, the invention being concerned with multiple-turn coils of long lengths of strip material.

The invention is believed to have particular merit in its association with and employment of an expansible unwinding reel without the use of spools, sleeves, or cores retained within the coils of strip material; and the method of handling, treating, and delivering strip material in the form of self-supporting coils and under tension is believed to be unknown prior to this invention.

It will be apparent to one skilled in this art that other steps may be included in the process or method of this invention without departing from its intended spirit and scope, and that other forms of apparatus are susceptible of use therewith. While the invention finds its preferred application in rolling mill practice followed by winding, and unwinding followed by rolling of strip material under tension, it is within the intended purview of the claims appended hereto to apply the described method and apparatus to other working and processing operations.

What is claimed is:

1. A method of handling coiled strip material for rolling comprising placing a coil of strip material axially into position to be unwound, frictionally gripping the inner turn of strip material by substantially uniformly expanding pressure applied thereagainst at said position, preliminarily feeding the outer end of the strip material to a rolling position, engaging the outer end of the strip material for rolling, rolling the strip material to reduce the thickness thereof, unwinding the strip material from the coil by rolling, and resisting the passage of strip material to the rolling position by causing the strip material to follow a tortuous path, and by resisting free rotation of the internally gripped coil during rolling to an extent substantially equal to and not in excess of the frictional grip on the coiled strip.

2. A method of handling coiled strip material for rolling comprising placing a coil of strip material axially into position to be unwound, frictionally gripping the inner turn of strip material over substantially the full inner surface thereof while maintaining substantially the original curvature thereof by substantially uniformly ex-

panding pressure applied thereagainst at said position, preliminarily feeding the outer end of the strip material to a rolling position, engaging the outer end of the strip material for rolling, rolling the strip material to reduce the cross sectional thickness thereof, unwinding the strip material from the coil by rolling, placing the strip material in tension between the rolling position and the coil by causing the strip material to follow a tortuous path, further placing the strip material in tension by resisting free rotation of the internally gripped coil during rolling up to a maximum extent not exceeding the frictional grip on the coiled strip, and controlling the effective total tension in the strip material on delivery to the rolling position by adjusting the respective amounts of tortuous path-tensioning and rotational resistance-tensioning.

3. A method of handling strip material and delivering the same for processing comprising forming a relatively long length of strip material into a self-supporting coil having closely and tightly woundturns, transporting the strip material in coil form to a position from which it may be delivered for processing, placing the coil axially into position to be unwound, frictionally engaging the inner turn of strip material by expanding pressure applied thereagainst at said position, engaging the outer end of the strip material for processing, progressively processing the strip material, unwinding the strip material from the coil by the pull induced in processing, and placing the unwinding strip material in tension at a value substantially above that required to hold the same taut but not greater than the value maintained in the strip material when first formed into a coil by resisting free rotation of the internally engaged coil during processing.

4. A method of handling strip material and delivering the same for working comprising coiling a relatively long length of strip material into a self-supporting, closely and tightly wound, spiral coil while maintaining tension in the strip material at a value substantially above that required to keep the same taut, transporting the strip material in coil form to a position from which it may be delivered for working, placing the coil axially into position to be unwound, frictionally engaging the inner turn of strip material by expanding pressure applied thereagainst at said position, engaging the outer end of the coiled strip material for working, progressively working the strip material, unwinding the strip material from the coil by the pull induced in working, and placing the unwinding strip material in tension at a value substantially above that required to hold the same taut but not greater than the value maintained in the strip material when first coiled by resisting free rotation of the internally engaged coil during working.

5. A method of handling and treating strip metal and delivering the same for rolling comprising forming a relatively long length of strip metal into a closely and tightly wound, self-supporting coil, transporting the strip metal in coil form whereby it may be brought to a thermal treating position, and whereby thermal treating of the strip metal in coreless coil form may be performed, including transporting the strip metal in coil form to a position from which it may be delivered for rolling, placing the coil axially into position to be unwound, frictionally gripping the inner turn of strip metal by substantially uniformly expanding pressure applied thereagainst at said position, preliminarily feeding the outer end of the strip metal to a rolling position, engaging the outer end of the strip metal for rolling, rolling the strip metal to reduce the cross sectional thickness thereof, unwinding the strip metal from the coil by rolling, resisting the passage of strip metal to the rolling position by causing the strip metal to follow a tortuous path to tension the same, additionally tensioning the strip by resisting free rotation of the internally gripped coil during rolling up to a maximum extent not greater than the effective frictional grip on the coil, and controlling the effective total tension in the strip metal at said rolling position by adjusting the respective amounts of tortuous path tensioning and rotational resistance tensioning.

6. A method of handling strip material and delivering the same for rolling comprising preliminarily wrapping a relatively long length of strip material into a self-supporting, closely wound, spiral coil while internally supporting the same, at the same time maintaining tension in the strip material at a value substantially greater than that required to keep the same taut, upon completion of the coiling operation axially displacing the coil from the winding position after releasing the same from internal support, transporting the strip material in coil form to a position from which it may be delivered for rolling, placing the coil axially into position to be unwound, frictionally engaging the inner turn of strip material in the coil over substantially the full inner surface thereof while maintaining substantially the original curvature thereof by uniformly expanding pressure applied thereagainst at said position, preliminarily feeding the outer end of the strip material on the coil to a rolling position, engaging the outer portion of strip material for rolling, rolling the strip material, unwinding the strip material from the coil by rolling, and placing the unwinding strip material in tension at a value substantially above that required to hold the same taut but not greater than the value maintained in the strip material when first coiled by substantially resisting free rotation of the unwinding internally engaged coil during rolling.

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