A decoiling device for decoiling a coil of sheet material includes first and second support rollers on which to support a coil of sheet material. The first and second support rollers are oriented such that their rotation axes are parallel to a first direction. The decoiling device also includes a frame supports the first and second support rollers, a rotatable mandrel, and first and second guide members. The first and second guide members are positionable at first and second sides of the frame, respectively, so as to limit movement of the coil of sheet material in the first direction. Multiple such decoiling devices can be configured together with a support member that supports the multiple decoiling devices to provide a mobile multi-coil decoiling system that is transportable from one location to another.

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SHEET METAL DECOILING DEVICE AND MULTI-COIL DECOILING SYSTEM

Cross Reference to Related Application

Field of the Invention
[0002] The present disclosure relates to metal building construction, and particularly to providing feed material for metal building construction equipment at a job site. The disclosure more particularly relates to a decoiling device for sheet metal and other feed material for metal building construction.

Background of the Invention
[0003] In the metal building construction process, it is necessary to provide feed material for the crimping, roll-forming, and fastening operations that comprise metal building construction. Typically the feed material, such as sheet metal of varying gauges, is manufactured, shipped, and stored in large diameter coils. The coiled feed material must be decoiled before it is fed into any apparatus that will perform the aforementioned crimping, roll-forming, and fastening operations. A known example of a decoiling device to decoil a large steel coil for feeding the steel into a roll-forming machine or the like, hereinafter referred to as a forming machine, is an expanding mandrel type decoiling device. In the expanding mandrel decoiling device, a coil of feed material slides over a mandrel that expands to contact the inner diameter of the coil. The coil is supported by the mandrel, which includes a rotating shaft that supports the weight of the coil, so that the coil of material is unrolled or decoiled, and then fed into a roll-forming machine. Other devices such as a drum type decoiler are known, wherein the coiled feed material slides on a drum and is then fed into a roll-forming machine.

[0004] There are significant safety issues presented by the prior art decoiling devices. The most significant dangers result from the nature of the feed material,
specifically sheet metal. When the sheet metal is manufactured and rolled into coils, the resilience of the sheet metal can cause the coils to unroll unless the coils are secured. To prevent undesired unrolling, sheet metal coils are generally wound tightly and secured with circumferential strip-metal bands to hold the coil of sheet material in place. When operating any decoiling device, and particularly a conventional expanding mandrel type decoiler, the operator must physically release the coil of steel by releasing the circumferential band or bands. Once such circumferential bands released, the coil can unravel very rapidly, thus creating a potential hazard for anyone nearby.

[0005] Another difficulty in working with coiled sheet metal is commonly called telescoping. Telescoping is the result of inner layers of the coiled material shifting axially slightly off center, so that one end of a layer extends beyond an end of the coil, while the opposite end of that layer recedes inside the coil. The stress produced by a single telescoped layer applies a similar axial displacing force on the adjacent layer, and the effect cascades through the layers producing the telescoping phenomenon. In its most extreme, the steel coil becomes telescoped in a manner such that the axis of the coil is so skewed from the axis of the inner telescoped layers, that the coil is functionally detached from the inner most layers. At this point the skew in the layers of the coil can render the coil unusable. The operator then must manually straighten the coils out before they can be fed into a roll-forming machine.

[0006] The difficulty of preventing and/or correcting the skewing or telescoping of coils can be exacerbated by stress conditions that the coiled material can acquire during storage. For example, when coiled steel is stored in a location where it is exposed to the elements, ambient temperature variations create stress in the material through thermal expansion and contraction of the material. Furthermore, oxidation can cause variations the thickness of individual layers of coiled sheet metal, thus creating more stress in the coiled sheet metal. These naturally-occurring stresses are naturally relieved by telescoping. In other words, telescoping is a naturally occurring and expected consequence of coiling sheet metal or other resilient sheet building material.

[0007] The present inventors have observed a need for a device that will simultaneously and safely accomplish the tasks of facilitating the safe removal of
circumferential bands from coiled feed material and correcting/preventing the problem of coil telescoping, all within the same device as a decoiling mechanism.

**Summary of the Invention**

[0008] In order to overcome the above-mentioned shortcomings of the related art, it is an object of the present invention to provide a device for decoiling sheet metal or other building construction sheet feed material. It is a further object of the invention to provide a decoiling device for decoiling sheet material that overcomes the safety hazards associated with conventional decoiling. It is another object of the present invention to provide a decoiling device for decoiling sheet material that permits the safe removal of circumferential bands from the coiled material. It is another object of the present invention to provide a sheet material decoiling device that permits the safe correction of telescoped coils of sheet feed material for varying conditions of previously stored coiled material. It is another object of the present invention to provide a decoiling device configured to enhance safety by preventing a coil of sheet material from becoming unintentionally dislodged from the decoiling device. It is another object of the present invention to provide such advantages via the same decoiling device.

[0009] According to an exemplary embodiment, a decoiling device for decoiling a coil of sheet material is described. The decoiling device (also called a decoiler herein) comprises first and second support rollers on which to support a coil of sheet material. The first and second support rollers (e.g., comprising stainless steel roller surfaces) are oriented such that their rotation axes are parallel to a first direction. The decoiling device also comprises a frame that supports the first and second support rollers, a rotatable mandrel, and first and second guide members. The first and second guide members are positionable at first and second sides of the frame, respectively, so as to limit movement of the coil of sheet material in the first direction.

[0010] In an exemplary aspect, the first and second guide members can comprise first and second guide rollers (e.g., comprising stainless steel roller surfaces), respectively. In addition, each of the first and second guide rollers can be positioned midway between the first and second support rollers, wherein rotation axes of the first
and second guide rollers are oriented in a vertical direction relative to a plane intersecting the rotation axes of the first and second support rollers.

[0011] In another exemplary aspect, the frame can be configured to allow displacement of the rotatable mandrel in a vertical direction relative to a horizontal plane intersecting the rotation axes of the first and second rollers. Also, the frame can be configured to substantially constrain displacement of the rotatable mandrel in a direction perpendicular to the vertical direction. In another exemplary aspect, the frame can comprise a retaining mechanism to prevent the mandrel from exceeding a maximum displacement in the vertical direction. In another exemplary aspect, the rotatable mandrel can be expandable. In another exemplary aspect, the decoiling device can comprise an adjustment mechanism that permits at least one of the first and second guide members to be moved in the first direction.

[0012] According to another exemplary embodiment, multiple decoiling devices can be supported together by a support member to provide a multi-coil decoiling system, which may comprise a mobile platform (e.g., a trailer or a truck) that includes the support member. In such a mobile multi-coil decoiling system, two, three, four, five or more coils could be provided on a single trailer or truck, for example (five coils is advantageous).

Of course, any suitable number of decoilers could be used depending upon the weight and size considerations of both the coiled material and the trailer. According to another exemplary aspect, a mobile multi-coil decoiling system can feed sheet material from a given decoiling device into a forming machine, which may be located on a separate but adjacent facility (e.g., an adjacent trailer).

[0013] The exemplary decoiling device can remove and further prevent telescoping of the coil of sheet material by virtue of the guide members, which are preferably guide rollers, and which are positionable at sides of the coil. The guide rollers are positioned to limit movement of the coil in the first direction parallel to the rotation axes of the first and second support rollers. In particular, the guide rollers can be positioned so that both guide rollers contact opposing ends of the coil of sheet material to prevent telescoping. The prevention of telescoping not only avoids mechanical difficulty associated with feeding the sheet material to a forming machine or other apparatus, but also enhances safety to an operator. The location of the guide rollers midway between the
first and second support rollers accommodates the diminishing radius of the coil of sheet material without the need for adjustment of the guide rollers during decoiling (because the rotation axes of the guide rollers are always oriented toward the rotation axis of the coil of sheet material regardless of how much sheet material has been decoiled). The exemplary decoiling device can be configured to permit the operator to control the positioning of either or both of the guide rollers either manually or with powered assistance. In a manual operation, the operator can simply rotate a hand wheel crank to position the guide rollers at sides of a coil of sheet material. A power-assisted, semiautomatic operation can be implemented by using electrical and/or hydraulic devices (e.g., motors and/or pistons) to position the guide rollers.

During normal operation of the exemplary decoiling device, the two support rollers, rather than the rotatable mandrel, support the weight of the coil of sheet material. The support rollers permit the coil rotate such that sheet material can be fed into a forming machine or other apparatus. The use of two support rollers and a frame configured to allow displacement of the rotatable mandrel in the vertical direction is advantageous because the device can thereby automatically accommodate the diminishing radius of the coil of sheet material as material is removed —as the coil radius becomes smaller, the coil naturally shifts downward in the vertical direction, and the rotatable mandrel shifts downward vertically with the coil.

The use of two support rollers also provides for straightforward loading of the coil into the decoiling device and straightforward operation of the decoiling device, and provides greater safety than if the weight of the coil were supported only by a rotatable mandrel. For example, the exemplary decoiling device can enhance safety in removing circumferential strip bands from coiled sheet material because the weight of the coil can keep the outer surface of sheet material firmly in contact with the support rollers, thereby preventing the coil from unraveling uncontrollably when the circumferential bands are cut. This configuration provides a very safe operation for the operator.

The retaining mechanism of the exemplary decoiling device, which prevents the rotatable mandrel from exceeding a maximum displacement in the vertical direction, in combination with the frame configuration that substantially constrains displacement of the rotatable mandrel in a direction perpendicular to the vertical
direction, can enhance safety by preventing the coil from escaping the device should there be a malfunction with a forming machine, a mishap in transporting/positioning the decoiler device, or other type of accident. The expandable, rotatable mandrel can expand within the inner diameter of the coil so as to contact firmly the inner surface of the core of the coil. If some occurrence (e.g., stresses within the coil) applies forces that would tend to impel the coil off the decoiling device, or if the coil becomes dislodged from the support rollers, the retaining device can restrain the movement of the rotatable mandrel within certain limits, thereby preventing the coil from becoming dislodged from the decoiling device. This retaining device is designed to handle the weight of the coil.

[0017] According to another aspect, the design of the decoiling device permits the operator to control the rotation of the coil of material so that it feeds into a forming machine or other apparatus, which can all be done with one hand from a location separated from the coil itself, for example, using a remote electrical control that controls decoiler drive motors.

[0018] The design of the exemplary decoiling device can permit safe and continuous operation even before the operator intervenes to correct any of the above-described problems that can occur with the decoiling device. The exemplary decoiling device can be used with building machines, which are known in the art for roll-forming self-supporting steel buildings. When the decoiling device is used with a building machine, such as a roll-forming machine, the decoiling device can provide both control and safety to a single operator while the coiled material is being fed into the building machine.

**Brief Description of the Drawings**

[0019] Figure 1 schematically shows a side elevation of an exemplary building machine showing the decoiler installed.

[0020] Figure 2A is a perspective view of an exemplary mobile multi-coil decoiling system.

[0021] Figure 2B illustrates side and top views of the mobile multi-coil decoiling system shown in Figure 2A.
Figure 2C is a partial side elevation of the exemplary mobile multi-coil
decoiling system shown in Figure 2A.

Figure 3A is a perspective view of an exemplary decoiling device.

Figure 3B is a perspective view of another exemplary decoiling device.

Figure 4A is a front view of the exemplary decoiling device shown in
Figure 3A.

Figure 4B is a front view of the exemplary decoiling device shown in
Figure 3B.

Figure 5A is a side view of the exemplary decoiling device shown in
Figure 3A with chain guard and chain removed.

Figure 5B is a side view of the exemplary decoiling device shown in
Figure 3B with chain guard and chain removed.

Figure 6A illustrates an exemplary anti-telescoping roller subassembly.

Figure 6B illustrates another exemplary anti-telescoping roller
subassembly.

Figure 7 is a perspective view of another exemplary decoiling device.

Figure 8 is a partial end view of the exemplary decoiling device shown in
Figure 7.

Figure 9 is a perspective view of another exemplary decoiling device.

Figure 10 is an illustration of an exemplary control panels for use with
exemplary decoiling devices.

Figure 11 is an illustration of other exemplary control panels for use with
exemplary decoiling devices.

Figure 12 is a partial cross-sectional view of an exemplary adjustable,
rotatable mandrel arranged in a short configuration.

Figure 13 is a partial cross-sectional view of the exemplary adjustable,
rotatable mandrel of Figure 12 arranged in a long configuration.
Detailed Description of the Preferred Embodiments

Reference will now be made in detail of exemplary embodiments of the invention, as illustrated in the accompanying drawings. Whenever possible, similar reference numbers will be used throughout the drawings to refer to the same or like parts.

Figure 1 shows a left-side view of an exemplary decoiling device 1 mounted on a support member of a self-contained building machine 2. The decoiling device 1 is mounted at the front of the trailer that supports the self-contained building machine 2. A coil 3 of sheet material (e.g., steel) is mounted on the decoiler 1 so that sheet material from the coil 3 can be fed into the building machine 2 for a roll-forming operation. An operator can employ the control panel 10 to control the decoiler's electrical and/or hydraulic mechanisms. The decoiling device 1 could be manually operated, instead of electrically or hydraulically operated, if desired, to suit the needs of the customer. The control panel 10 permits the operator one-handed control of the decoiling device 1. Specifically, a single human operator can use one hand to set the coil on the machine, remove any telescoping of the coil, and then feed sheet material from the coil into the forming machine for processing.

Figure 2A shows an exemplary embodiment of a mobile multi-coil decoiling system 4. The mobile multi-coil decoiling system 4 is a machine that may be used as an accessory to the self-contained building machine 2. The mobile multi-coil decoiling system 4 is equipped with multiple (e.g., two, three, four, five, etc.) coils, and has the capacity to contain more or less coils, depending on customer and job site requirements. In the example shown, there are five decoiling devices mounted on a support member 4A (e.g., platform) of the trailer. The control box 10 operates these decoilers, and can provide control (e.g., with push buttons and/or other switches) for the operation of all five decoilers by a single human operator. The control box 10 can permit the operator to select any of the decoilers for coils 5-9. Once the operator selects a decoiler, he can then either engage the anti-telescoping feature or start a coil rotation motor, thus feeding sheet material into a self-contained building machine 2 positioned adjacent to the mobile multi-coil decoiling system 4. In an exemplary embodiment, coils 5-9 can feed from the top, allowing, for example, an operator to feed sheet material from one coil (e.g., coil 5) over the tops of the other coils into the self-contained building.
machine 2 adjacent to the mobile multi-coil decoiling system 4. This feature provides the very desirable feature of eliminating the requirement of constantly loading coils of material. Multiple coils can be loaded on the mobile multi-coil decoiling system 4 for easy access, and, when desired, the operator can simply operate the decoilers one at a time and allow them to feed sheet material into the self-contained building machine 2. Such drive functions could be electric, hydraulic, manual, or any suitable combination thereof, to suit the needs of the customer.

[0041] Figure 2B shows a side view of the mobile multi-coil decoiling system 4 as well as a top view. As shown in this picture there are a number of coils 5-9 mounted to the mobile multi-coil decoiling system 4, and the number of coils can vary depending on size and weight limitations of the trailer. The trailer can be used to carry multiple coils of sheet material (e.g., steel, aluminum, other sheet metal, etc.), depending on the design; this particular example illustrates five coils. A strap 80 is wrapped around each coil and tied down to the trailer via tie downs 81. This tie-down method is used for all coils to allow safe transport over the road.

[0042] Figure 2C shows a partial side view of an end of the mobile multi-coil decoiling system 4. This view shows the two rear most coils 8 and 9. A closer view of the strap 80 is shown in this particular view. The strap 80 can be tightened or loosened with a ratchet-type mechanism well known to those skilled in the art. Of course, any suitable mechanism for securing and tightening the coils 5-9 to the support member 4A could be used (e.g., an over-center device). Tie downs 81 are provided with several holes to allow the hooks from the straps to be inserted. The tie downs 81 can be welded to the trailer frame in a permanent fashion so as to prevent the coils from dislodging from the mobile multi-coil decoiling system 4. The optional electrical control box 10 is also shown.

[0043] Figure 3A shows a perspective view of the exemplary decoiling device 1. The decoiling device 1 comprises first and second support rollers 34 and 35 on which to support a coil of sheet material. The first and second support rollers 34 and 35 are oriented such that their rotation axes are parallel to one another. The decoiling device 1 also comprises a frame 61 that supports the pair of support rollers 34 and 35. The decoiling device 1 also comprises a rotatable mandrel 20 configured to be inserted into a
central opening of the coil of sheet material, and that is also adjustable (i.e., expandable and contractable), as will be discussed further below.

[0044] The first and second support rollers 34 and 35 can each comprise solid metal (e.g., stainless steel) shafts supported at each end by appropriate bearings 34A and 35A mounted to the frame 61. Alternatively, the support rollers 35 and 35 can each comprise a metal (e.g., stainless steel) cylinder that rides on a stationary metal shaft (e.g., stainless or hardened steel) via bearings between the support roller and its stationary metal shaft, wherein the stationary metal shaft can be rigidly attached to the frame 61. Moreover, each of the support rollers can comprise multiple, segmented rolling surfaces (e.g., multiple segmented cylinders) arranged end-to-end along the stationary metal shaft. Other variations will be apparent to those of ordinary skill in the art. As used herein a "roller" is intended to encompass any of various rolling cylinders, wheels, shafts, or other rolling mechanisms, whether segmented or continuous. Materials other than metals can be used for the roller surfaces of the support rollers such as, for example, hard rubber, plastics, polytetra-fluoroethylene (PTFE), and others, as will be appreciated by those of ordinary skill in the art.

[0045] In addition, Figure 3A shows first and second guide rollers 22 and 41 as examples of first and second guide members, which are supported by the frame 61. The first and second guide rollers 22 and 41 are positioned at opposing sides of the frame 61 midway between the first and second support rollers 34 and 35 such that rotation axes of the first and second anti-telescoping are oriented in the vertical direction. Guide rollers 22 and 41 preferably have stainless steel rolling surfaces that contact the ends of the coil of sheet material. However, materials other than metals can be used for the guide roller surfaces such as, for example, hard rubber, plastics, polytetra-fluoroethylene (PTFE), and others, as will be appreciated by those of ordinary skill in the art. As with the support rollers 34 and 35, any suitable configuration of roller can be used for the guide rollers 22 and 41 (e.g., the roller can comprise solid shaft mounted on a bearing attached to the frame, a cylinder that rides an internal shaft via suitable bearings, etc.). While the use of guide "rollers" is advantageous, other types of guide members can also be used, such as non-rotating steel bars having flat or curved surfaces that are polished to reduce friction or that are treated (e.g., with PTFE) to reduce friction. Also, while two guide members
(e.g., guide rollers) are illustrated in the example of Figure 3A, it will be appreciated that more than two suitably positioned guide members could be used.

[0046] The coil of sheet material will rest on support rollers 34 and 35. Before the coil is rested, the rotatable mandrel 20 will be inserted into the coil. The rotatable mandrel 20 can comprise multiple (e.g., three) adjustable (expandable/contractable) portions such as, for example, scissor type mechanisms controlled by handle crank 24. The turning motion on the handle crank forces push tube 25 to exert pressure onto the scissor movement tube 19 which rides along a central arbor 20A. This action causes link bars 31 to move in a scissor action. The link bars are directly attached using a bolt and slot action to t-angles 21. Once the rotating force on the handle is applied, the motion will then cause the scissor mechanism to either extend or retract depending on the motion of the handle. The spring 18 is provided to keep pressure on the scissor mechanism to prevent unwanted movement when transporting this metal device from coil to coil and to make the use of the device easier. When the rotatable mandrel 20 is mounted inside the coil and placed on the decoiling device, the ends of the adjustable mandrel 20 protrude through the vertical openings 61A in the frame 61. The frame 61 is configured to substantially constrain displacement of the adjustable mandrel 20 in a direction perpendicular to the vertical direction to prevent the coil from jumping or dislodging from the decoiling device. In this regard, displacement of the adjustable mandrel can be substantially constrained by restricting the available lateral displacement of the mandrel to a distance equal to about four diameters of the central arbor 20A. This can be achieved, for example, by utilizing vertical openings (slots) 61A in the frame 61 that have a width of about four diameters of the central arbor 20A, or less.

[0047] Swing brackets 37 (shown in Figure 3B, but removed in the view of Figure 3A) can serve as a retaining mechanism that keeps the rotatable mandrel 20 constrained within a maximum displacement in the vertical direction. If an unexpected force is applied to the coil (e.g., an adjacent roll forming machine applies an unexpected force via the sheet material being fed into the roll forming machine), these swing brackets 37 can prevent the coil from being propelled from the decoiler 1.

[0048] In the example of Figure 3A, the position of guide roller 41 is fixed relative to the frame 61. The guide rollers in this example comprise cylindrical members
that rotate via bearings 42. The guide roller 41 is designed to withstand the side force of the coil as it is inserted into the machine and will limit the movement of the coil in the transverse direction parallel to the rotation axes of the support rollers 34 and 35. A moveable roller assembly comprising roller 22 on the opposite side of the frame 61 is operated by crank handle 67. The turning motion of the crank handle 67 through shaft 66 will cause the guide roller 22 to move inward toward guide roller 41 or outward. By moving the roller 22 toward roller 41, both guide rollers 41 and 22 can be brought into proximity (e.g., contact) with sides of the coil of sheet material to thereby correct and/or prevent telescoping. As described in this disclosure the telescoping of the coils can be a major problem. This guide roller assembly can help reduce the telescoping portions of the coil by applying a physical force to the end of the coils thus pushing the telescoped material back into the main body of the coil. The rotating shaft 66 attached to the crank handle 67 has a spherical bearing 65 mounted to a stationary bracket 64 and is connected to a lead screw through a pair of bevel gears. The lead screw provides the linear motion for the roller, as will be described later. Although guide roller 41 has been illustrated in this example as a stationary guide roller, it will be appreciated that one or both of the guide rollers 22, 41 positioned at opposing sides of the decoiling device 1 can be configured as movable guide rollers using an adjustment mechanism as described above.

As shown in Figure 3A, the frame 61 can be configured to allow displacement (e.g., 6 inches, 12 inches, 18 inches, 24 inches, etc., or other suitable displacement) of the rotatable mandrel 20 in a vertical direction relative to a plane (i.e., a mathematical plane) that intersects the rotation axes of the first and second rollers by allowing the mandrel to move vertically in the slots 61A in the frame 61. It will be observed that the slots 61A in the frame 61 substantially constrain displacement of the mandrel 20 in a direction perpendicular to the vertical direction because the mandrel 20 can only move in the horizontal direction by an amount corresponding to the width of the slots 61A. The frame 61 can also be configured to prevent the mandrel 20 from exceeding a maximum displacement in the vertical direction by virtue of a retaining mechanism (e.g., swing brackets 37 shown in Figure 3B, but removed in the view of Figure 3A) configured with the frame. While the example of Figure 3A illustrates using slots 61A in frame 61 to substantially constrain the motion of the mandrel 20 in the
horizontal direction, other approaches will be apparent to those skilled in the art. For example, vertical posts could be mounted at each side of the frame as a substitute for slots, and the shaft of the mandrel could be configured with collars at each end so as to slide up and down over the vertical posts. In such an arrangement, removable collars with an appropriate retaining mechanism (e.g., locking pins or set screws) could be attached at the top or elsewhere on the vertical posts to provide a suitable retaining mechanism to constrain the vertical motion of the mandrel.

[0050] Figure 4A shows an end view of the decoiling device 1 illustrated in Figure 3A. This view shows movable guide roller 22 in the outward position before it contacts the coil. The outward position is used for loading and unloading coils. Stationary guide roller 41 is rotatably mounted to bearing 42 on the stationary side. In this view the coil stock is pushed directly against the stationary roller. The crank handle 67 when turned will cause movable guide roller 22 to move inward to remove and prevent any telescoping of the coil by contacting the coil of sheet material as it rotates within the decoiling device.

(0051) Figure 5A shows a side view of the decoiler 1 illustrated in Figure 3A and illustrates a motor 51 (e.g., a hydraulic or electric motor) which is attached to sprocket 33. The sprocket 33 is configured to drive a sprocket 33A on the support roller nearest the motor 51 with a chain (not shown). The support roller nearest the motor 51 can include two such sprockets near the end of a drive shaft of the support roller, one of which is driven by a chain connected to sprocket 33, and the other of which drives another sprocket 33B attached to the other support roller via another chain (not shown). Of course other types of drive mechanisms other than a chain drive, such as a belt drive or a gear drive with a rotating drive shaft, could be used to drive the support rollers. Thus, when hydraulic motion is applied to motor 51, the motor turns and drives the support rollers via sprockets 33A, 33B and 33C, thereby causing the coil to spin in a desired direction (either clockwise or counterclockwise). The configuration of this example allows easy, one-handed operation of feeding sheet material from the coil into a roll-forming machine using the controller 10, which controls the motor 51. The use of the motor 51 is very beneficial for this purpose.
In addition, one or both of the support rollers can be configured with manual drive portion 90 (shown in Figure 4A), such as a bolt head that is directly mounted to an end of one of the support rollers that can be turned with a wrench, or such as a suitably shaped slot that can be driven with an insertable handle driver. Thus, using a wrench or a handle, a support roller can be turned, thereby turning the coil, without the aide of a motor. This feature can be beneficial should some type of adjustment be necessary or should there be a loss of power, for example. Of course, a tangential force imparted to the coil of sheet material by the pulling of the sheet material itself can cause rotation of the coil (e.g., wherein a drive mechanism of an adjacent roll forming machine pulls on the sheet material).

Figure 3B illustrates another exemplary decoiling device 1A having an alternate mechanism for adjusting the movable guide roller 22. Decoiling device 1A is similar to decoiling device 1 of Figure 3A in many respects. In this example, instead of having a crank handle disposed at the front of the decoiler (such as shown in the Figure 3A example), an adjustment mechanism for moving the movable guide roller 22 is arranged at the side of the decoiling device 1A. In particular, for example, an insertable crank handle 67 can be inserted into a slot 63A to drive the guide roller inward toward the opposing guide roller 41 or outward therefrom. Collar 63 is used to support the handle 67 as it is turned clockwise or counterclockwise. The roller 22 will move transversely (axially) towards roller 41 to tighten the coil. While a slot 63A and an insertable handle 67 are shown in this example (e.g., with the slot and handle end being square-shaped to provide a square drive), any suitable drive mechanism can be used to drive the movable guide roller 22.

Also shown in the example of Figure 3B is an additional safety device 72 that can further prevent the coil from dislodging from the decoiler and which can further stabilize the coil during normal operation. The safety device 72 comprises a main plate with glide plate material mounted thereon and also comprises a roller 71 made of, for example, a plastic type material or any type of non-scratching material (e.g., hard rubber, PTFE, etc.) to provide the additional safety and stabilization functions without damaging the sheet material. It will be appreciated that a coil may tend to dislodge from a decoiler when a small amount of sheet material is left on the decoiler, because the small amount of
sheet material can tend to spring open since the weight of the coil may no longer be sufficient to hold the sheet material firmly against the support rollers. The safety device 72 can stop the coil from springing and exiting the decoiler mechanism.

[0055] Figure 4B illustrates an end view of the exemplary decoiler IA shown in Figure 3B. Handle 67 is shown in the removed position. When inserted into the proper position and turned clockwise or counterclockwise, guide roller 22 will move transversely towards the coil and will push the coil against guide roller 41 to provide contact to thereby remove/prevent telescoping of the coil.

[0056] Figure 5B shows a further perspective view of the exemplary decoiler IA of Figure 3B with a coil of sheet material mounted on the decoiler IA. As illustrated in Figure 5B, the slot 61A in frame 61 and the associated swing bracket are configured to limit displacement of the coil in the horizontal direction, and the safety mechanism 72 can further prevent unwanted dislodging of the coil from the decoiler IA.

[0057] Also shown in Figure 5B is the motor 51 (e.g., a hydraulic or electric motor) which is attached to sprocket 33, which can drive the sprocket 33A attached to the nearest support roller via a chain (not shown). Sprocket 33C, also attached to this support roller, can drive sprocket 33B attached to the other support roller via a chain (not shown). According to a further exemplary aspect, sprocket 33A can be mounted to the shaft of the nearest support roller via a clutch mechanism 69 (e.g., a cam clutch) disposed between the roller shaft and the sprocket 33A. This configuration allows full automatic feed of sheet material from the decoiler into an adjacent panel forming machine or other forming apparatus (not shown). In normal operation, for example, the panel forming machine or other apparatus could run faster at times than the decoiler IA. In such instances, the cam clutch 69 can allow disengagement of the sprocket 33A during operation and allow the support rollers to roll freely, thereby allowing the coil of sheet material to decoil at a rate governed by the panel forming machine or other apparatus into which the sheet material is being fed. When the weight of the coil of sheet material is diminished to the point where the weight of the sheet material would not provide enough friction against the support rollers to keep the support rollers turning at the rate governed by the panel forming machine or other apparatus, the support rollers would then slow, thereby allowing cam clutch 69 to engage such that the hydraulic motor 51 would turn the support
rollers. Thus, the support rollers would turn at all times, albeit at potentially different rates depending on the weight of the coil of sheet material. This aspect can allow seamless operation of the decoiling device IA in conjunction with a panel forming machine or other apparatus into which the sheet material is being fed.

[0058] Figure 6A illustrates a partial three dimensional view of an exemplary movable guide roller subassembly suitable for use with the exemplary decoiling device of Figure 3A. Moveable guide roller 22 is shown in a phantom type view and can be seen rotatably mounted to shaft 49 via bearings 48 and 50. Bearings 48 and 50 are used to provide a low friction mechanism so that the roller 22 will spin more freely. A washer cap 47 keeps the roller 22 constrained to the shaft 49. Moveable block 43 slides via the grooves in the end blocks 44 and 45. As rotation is applied from shaft 66 (see Figure 3A) from the crank handle 67, a drive gear 56A attached to block 56 provides rotating force to motor gear 60. The turning motion of this motor gear 60 is applied to shaft 52. Shaft 52 includes a partial acme type thread which applies screw motion to sliding block 43. This linear motion will allow sliding block 43 to move back and forth between blocks 44 and 45. Thus, movable guide roller 22 can be positioned to contact the side of the coil to thereby provide an anti-telescoping function for the decoiling device IA. It will be appreciated that one or both of the guide rollers positioned at opposing sides of the decoiling device can be configured as movable guide rollers using such an adjustment mechanism.

[0059] Figure 6B illustrates a partial three dimensional view of an exemplary movable guide roller subassembly suitable for use with the exemplary decoiling device of Figure 3B. The subassembly shown in Figure 3B has a different type of adjusting mechanism with one common shaft 52, which is a threaded device and which moves slide block 43 relative to end blocks (receivers) 44 and 45 similar to the other type of device which was explained previously. In Figure 6B, shaft 52 is shown as terminated at a surface of the subassembly, but actually would extend a sufficient distance so as to mate with collar 63 shown in Figure 3B and would include a slot or other drive connection adapted to accommodate the handle 67 shown in Figure 3B. It will be appreciated that one or both of the guide rollers positioned at opposing sides of the decoiling device can be configured as movable guide rollers using such an adjustment mechanism.
Figure 7 illustrates a perspective view of another exemplary decoiling device IB, e.g., for the mobile multi-coil decoiling system 4, and Figure 8 shows an end view of the decoiling device IB. The decoiling device IB is similar to devices 1 and IA of Figures 3A and 3B in many respects. Two support rollers 34 and 35 (e.g., solid metal shafts riding on bearings mounted to frame 61) are used to support the weight of the coil. Moreover, the decoiling device IB includes a sliding plate 101 with a guide roller 22 attached thereto, wherein the position of the sliding plate is adjustable to accommodate coils of different widths. The mobile multi-coil decoiling system 4 shown in figures herein can carry multiple width coil stock on a trailer, and such multiple widths can typically range from 18 inches to 40 inches. Of course, the coil dimensions are not limited to these exemplary widths, and any suitable coil dimensions can be accommodated with different sizes of decoilers.

A locking handle 105 (friction mechanism) is used to release main sliding plate 101, which is connected to a slotted friction plate 103 via a movable bar 103A. The movable bar 103A extends through a slot in frame 61 and is connected to main sliding plate 101 via a hinge connection 103B. When the locking handle is turned 1/4 turn, for example, frictional force from friction washer 106 is released from the friction plate 103. This allows sliding plate 101 to move transversely within the decoiler IB along support rollers 34 and 35. As the sliding plate 101 moves inward, for example, the movable bar 103A swings at hinge 103B, and the locking handle 105 connected to an end of the movable bar 103A slides toward support roller 34. When the desired position of the sliding plate 101 is achieved such that the guide rollers 22 and 41 contact the coil, the locking handle 105 is then tightened. Friction washer 106 will apply frictional force between friction plate 103 and movable bar 103A and will maintain the position of main sliding plate 101. This adjustment mechanism allows the guide rollers 22 and 41 to contact the coil and apply pressure on the coil so as to prevent the coil from moving transversely and can thereby correct and/or prevent telescoping of the sheet material. An adjustable mandrel 20 such as previously described in this disclosure is also used with the exemplary decoiler IB to prevent unwanted dislodging of the coil from the decoiling device.
As shown in Figure 8, it can be seen that guide rollers 22 and 41 can be positioned to contact the coil of sheet material. These guide rollers can be mounted to the frame 61 and the main sliding plate 101 via suitable bearings 114 and 116 and suitable mounting brackets and hardware.

Figure 9 shows another exemplary decoiling device 1C that can be used with a multi-coil decoiling system 4. Decoiler 1C utilizes two main side plates 61C and 61D of frame 61. Structural members that connect side plates 61C and 61D together are not shown to avoid obscuring the drawing. An aspect of this design is that guide rollers 91 and 92 can be removed from their present slots and inserted in the two respective slots 93 and 94 to make large adjustments in the positions of the guide rollers 91 and 92. Guide rollers 91 and 92 are held in place with pins 96. If a pin 96 is removed, the guide roller can be lifted straight up and inserted into an adjacent slot. This feature allows different size coils (e.g., wide coils or narrow coils) to be inserted into the decoiling device 1C. To provide further adjustment there is a crank mechanism 97, such as described previously herein, at the right side that allows crank handle (not shown) to drive an adjustment mechanism, such as previously described herein, to provide fine adjustment of roller 92 to accommodate different coil widths. For example, fine adjustment of 1, 2, 3, 4, 5 or more inches of displacement could be provided with such an adjustment mechanism. This design can be advantageous in that it requires relatively little material, provides an inexpensive design, and allows for an easy method adjustment.

Figure 10 shows a partial front view of exemplary control panels 10 that can be used for both a given decoiling device and a mobile multi-coil decoiling system 4. As noted previously herein, hydraulic, electric, and/or manual drive mechanisms can be utilized with the decoilers to provide the desired decoiling motion. Control panels 10 for an electric or hydraulic version are shown with master switches 73, 78 to activate the controls. Anti-telescoping switches 72, 79 (either in or out) can control the positions of guide rollers, and a feed mechanism switch 71 can control a hydraulic or electric motor 51 to cause the decoiler to operate in forward or reverse. The disclosure is not limited to a certain type of control; Figure 10 illustrates exemplary control devices that can be used. Control panel 10 at the right of Figure 10 is a typical control panel for the mobile multi-coil decoiling system 4, wherein the user would simply select the coil number with switch
76. The reverse and forward control 74, 77 can be used to operate the hydraulic or electric motor to run in either forward or reverse. A master switch 73, 78 and an emergency stop 70, 75 allow the power to be deactivated. Other exemplary control configurations will be apparent to those skilled in the art.

[0065] Figure 11 shows additional exemplary designs of optional electrical control panels. Switch 122 allows operation of the decoiler in forward and reverse. A panel-former-only option can be used by turning switch 124 fully to the right position which allows controlling the forward and reverse motion of a panel former of the building machine 2 without controlling a decoiling device. A center position of switch 124 can allow the decoiler to be driven automatically in conjunction with the panel former machine. In this position the operator needs to do nothing but start the panel former (e.g., with a remote control device), and the decoiler can run at the same speed utilizing the cam clutch mechanism as explained before, thereby allowing full automatic operation of the decoiler. The master switch 110 is used for turning the unit on. Emergency stop 126 is used stop all devices in case of emergencies.

[0066] Figures 12 and 13 illustrate an exemplary rotatable mandrel 20 whose inner arbor 2OA is configurable in two lengths of the arbor 2OA, one for wide coils and one for short coils. The selectable lengths of the arbor 2OA can be whatever dimensions are suitable for the size of coils being used, e.g., such as 24 inches for short coils and 36 inches for wider coils. It will be appreciated that there are no limits to the standard dimensions of the coils. The dimensions of the arbor 2OA components can be designed so that the arbor 2OA can change length to provide custom short and long dimensions.

[0067] Figure 12 shows a partial cross-sectional view of the exemplary rotatable mandrel 20 with the arbor 2OA in a "short arbor" configuration. The exemplary mandrel 20 comprises a scissor mechanism such as previously described herein that permits the mandrel 20 to expand or contract so as to contact or recede from the inner coil surface at the opening of a coil of sheet material. As illustrated, crank handle 24 is nested within a push tube 25. Also a stabilizer tube 13 on the right side is shown in its short nested position. A very simple method to change the configuration to a "long arbor" configuration is illustrated in Figure 13. Figure 13 shows a partial cross section of the arbor 2OA and coil of sheet material. As illustrated, crank handle 24 pushes against push
tube 25. Also, stabilizer tube 13 is reversed 180 degrees compared to its position in Figure 12. A conversion between the short and long arbors only requires the reversal of 180 degrees of the both the stabilizer tube 13 and the push tube 25. The crank handle 24 will either nest within the push tube 25 in the short configuration or push against the push tube 25 in the long configuration. In a similar manner, the stabilizer tube 13 will either extend the arbor shaft or nest over the outer portion of the arbor shaft. In either case the push tube can push the link carrier 19 thus moving link arms 31 and expanding the mandrel 20 to the contact the inner diameter of the coil. The expansion of the mandrel 20 is accomplished through rotation of the crank handle 24 as described previously herein. This feature is convenient because it allows the user to use one adjustable, rotatable mandrel device for a variety of coils of different inner diameters. [0068] While this invention has been particularly described and illustrated with reference to exemplary embodiments thereof, it will be understood by those skilled in the art that changes in the above description or illustrations may be made with respect to form or detail without departing from the spirit or scope of the invention.
WHAT IS CLAIMED IS:

1. A device for decoiling a coil of sheet material, comprising:
   first and second support rollers on which to support a coil of sheet material, the
   first and second support rollers being oriented such that their rotation axes are parallel to
   a first direction;
   a frame that supports the first and second support rollers;
   a rotatable mandrel; and
   first and second guide members positionable at first and second sides of the frame,
   respectively, so as to limit movement of the coil of sheet material in the first direction.

2. The device according to claim 1, wherein the first and second guide members
   comprise first and second guide rollers, respectively.

3. The device according to claim 2, wherein each of the first and second guide rollers
   is positioned midway between the first and second support rollers, and wherein rotation
   axes of the first and second guide rollers are oriented in a vertical direction relative to a
   plane intersecting the rotation axes of the first and second support rollers.

4. The device of claim 1, wherein the frame is configured to allow displacement of
   the rotatable mandrel in a vertical direction relative to a plane intersecting the rotation
   axes of the first and second support rollers.

5. The device of claim 4, wherein the frame is configured to substantially constrain
   displacement of the rotatable mandrel in a direction perpendicular to the vertical
   direction.

6. The device of claim 4, wherein the frame comprises a retaining mechanism to
   prevent the rotatable mandrel from exceeding a maximum displacement in the vertical
   direction.
7. The device of claim 1, wherein the rotatable mandrel is expandable.

8. The device of claim 1, comprising an adjustment mechanism that permits at least one of the first and second guide members to be moved in the first direction.

9. The device of claim 1, wherein the rotatable mandrel comprises an arbor whose length is adjustable.

10. The device of claim 1, further comprising a motor configured to drive the first support roller via a drive mechanism coupled to the first support roller, wherein the drive mechanism includes a clutch mechanism.

11. A system for decoiling multiple coils of sheet material, comprising:
   multiple decoiling devices; and
   a support member that supports the multiple decoiling devices,
   wherein each decoiling device comprises:
   first and second support rollers on which to support a coil of sheet material, the first and second support rollers being oriented such that their rotation axes are parallel to a first direction;
   a frame that supports the first and second support rollers;
   a rotatable mandrel; and
   first and second guide members positionable at first and second sides of the frame, respectively, so as to limit movement of the coil of sheet material in the first direction.

12. The system of claim 11, comprising a mobile platform configured to be transportable from one location to another, wherein the mobile platform includes the support member.

13. The system of claim 12, wherein the mobile platform comprises a trailer or a truck.
14. The system according to claim 11, wherein the first and second guide members comprise first and second guide rollers, respectively.

15. The system according to claim 14, wherein each of the first and second guide rollers is positioned midway between the first and second support rollers, and wherein rotation axes of the first and second guide rollers are oriented in a vertical direction relative to a plane intersecting the rotation axes of the first and second support rollers.

16. The system of claim 11, wherein the frame is configured to allow displacement of the rotatable mandrel in a vertical direction relative to a plane intersecting the rotation axes of the first and second support rollers.

17. The device of claim 16, wherein the frame is configured to substantially constrain displacement of the rotatable mandrel in a direction perpendicular to the vertical direction.

18. The system of claim 16, wherein the frame comprises a retaining mechanism to prevent the rotatable mandrel from exceeding a maximum displacement in the vertical direction.

19. The system of claim 11, wherein the rotatable mandrel is expandable.

20. The system of claim 11, comprising an adjustment mechanism that permits at least one of the first and second guide members to be moved in the first direction.