Unwinding the Coil

The three basic methods for unwinding coils most commonly used are coil cradles, centering reels and pallet decoilers. The coil cradle, which is sometimes referred to as a coil box, holds the coil by its outside diameter cradling it on powered rollers called nest rolls. The second basic type of unwinder is the centering reel which holds the coil by its inside diameter over a mandrel with an expanding arbor assembly. The third type which are known as pallet decoilers or pan reels are used primarily in narrow strip applications. The coils are laid on their side and stacked on a pallet, which is then placed on a motorized turntable for unwinding. All three styles are available in a wide variety of configurations and have their own distinct advantages and disadvantages.

Regardless of the method chosen to unwind the coil, the performance requirements of the application must be satisfied in terms of payoff speed and acceleration/ deceleration time. The uncoiled drive will have to be sized to provide the power required to overcome friction, accelerate the inertia of the coil and any other rotating component to line speed prior to exhausting the stored material in the loop, overcome a drag tensioning brake if supplied, and run at the required production speed. The horsepower required is directly proportional to the torque and speed requirements. For a given application if the payoff speed requirement is doubled then the horsepower requirement will be doubled as well. Always use the worst case in terms of material thickness, width, coil size, and payoff speed to determine the drive size requirement for any application.

Until recently most unwinders were supplied with an AC motor, direct coupled, or with an air clutch, running at a fixed payoff speed, or possibly with a mechanical variable speed mechanism that was manually adjusted. Loop control consisted of a switching device (either mechanical or photoelectric) to turn the drive on and off without varying the payoff speed. Because the payoff speed wasn't generally matched to the actual production speed it meant that the system was continuously experiencing the shock of starting and stopping which takes its toll in terms of wear and tear and increased energy costs. Today, the majority of payoff equipment is supplied with an electronic variable speed drive, either DC, AC inverter or AC vector, which is controlled by a loop sensor that automatically varies the payoff speed to match that of consumption. This results in a smoother, more controlled payoff and eliminates material marking that can occur when starting and stopping the rollers on the strip. In addition, eliminating constant starts and stops yields longer component life and reduced energy costs.

Coil cradles are primarily used for medium to heavy gauge applications when material marking is not a consideration. With a cradle the coil is contained within a box or framework, which provides some degree of protection for the operator against material clockspring. The outer wrap is contained between the weight of the coil and the nest rolls as it is unwound. This is an advantage in preventing clockspring, and in controlling the coil for threading with heavy gauge or high strength material. But it can also be a problem with thin or cosmetically sensitive material as it tends to be marked or distorted as the outer wrap is squeezed between the weight of the coil and the nest rollers. It depends somewhat on the coil weight and width but normally running material less than .06" thick is not recommended in cradles.

Another disadvantage of the cradle style unwinder is that it isn't very good for rewinding and re-banding partially run coils. After running for a period of time in a cradle the coil tends to clockspring internally and the wraps become loose, making it impossible to re-band it into a nice tight coil. That is coupled with the fact that the banding material cannot be passed between the nest rolls and the coil which means that the outside of the coil can't be re-banded until it is lifted off of the nest rolls.

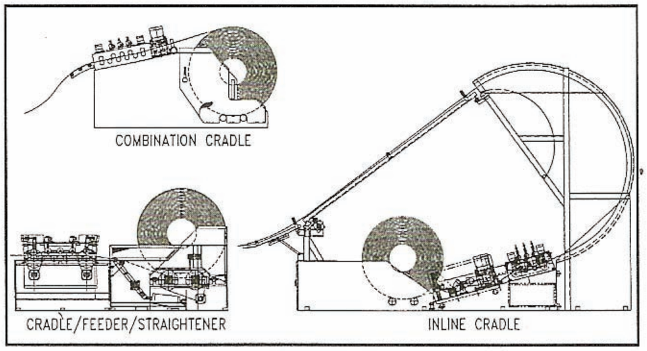

FIGURE 1

Coil cradles come in three basic configurations as shown in Figure 1. The first is what is known as a combination cradle/straightener or "combo" style, which unwinds the coil off of the top and pays off through a powered straightener into a horizontal loop. The combination style requires the greatest amount of floor space due to the horizontal loop, but because it offers unobstructed loading from the rear it lends itself well to quick coil changes with the addition of a spare coil load ramp.

The second type of coil cradle is called the inline style. It unwinds the coil off of the bottom into a vertical or overhead loop and is considered a space saving design because the loop area doesn't consume substantial floor space, although it can require substantial vertical height. This style sometimes incorporates a powered straightener but is also available with only a pair of pinch rolls to assist in peeling the material off of the coil. Basic models for small coils payoff directly from the nest rollers without the aid of pinch rolls or a straightener. The inline design facilitates threading of heavy gauge material because the leading edge of the coil is close to the nest rolls as it enters the pinch rolls. Since access to the nest rolls is usually blocked both front and back the use of a loading ramp for quick coil change is not an option with this style. The coil must be loaded from the top with an overhead crane or a lift truck and straps.

The third type of cradle is known as a cradle/feeder/straightener. It unwinds, straightens and feeds directly into the press without the need for a slack loop, making it a very compact, self-contained, complete coil feeding system. Normally powered by one or more closed loop servo drives, it usually pays off of the bottom of the coil and provides the same threading advantages as the inline style, but allows the use of a loading ramp for quick coil changes. Because this style requires that the coil be started and stopped in unison with the feed motion, it requires a great deal more horsepower than other cradles, which feed into a slack loop where unwinding is somewhat continuous. This is because the high mass of the coil must be accelerated and decelerated on each feed progression as opposed to running continuously into a slack loop as with the other styles. Due to the vastly increased load they are normally limited to slower speed applications and are often quite expensive due to the additional cost of high horsepower servo drives. In addition, the feeder/straightener concept isn't generally recommended for use with long progressive dies because it doesn't allow an effective pilot release unless the entire straightener bank is piloted.

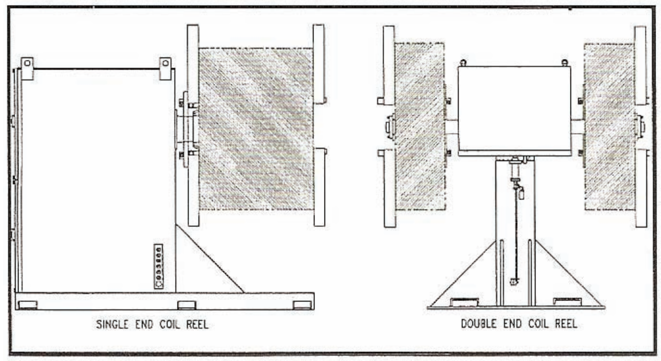

FIGURE 2

The second basic style of unwinder is known as a centering reel or horizontal reel shown in Figure 2. The coil is held by its inside diameter over an expanding arbor assembly which grips the coil's inside diameter. The coil reel is not only the most common method of unwinding but it is also the most versatile as well. Reels are ideal for light to medium gauge material or for non-marking applications because there is no contact with the outer wraps of the material as it is unwound, but they can also be used for heavy gauge or high strength materials if outfitted with the necessary equipment to safely contain coil clockspring and aid in threading such material.

Coil reels come in both powered and non-powered versions. Powered payoff reels are motorized with a loop control for payoff into a slack loop and are generally used in applications that don't require straightening. They can also be used in conjunction with a pull through straightener powered by a feeder at the press. Because the payoff speed varies as the coil diameter changes the maximum RPM requirement for the reel must be based on the rate of production calculated at the minimum coil diameter. As the coil diameter decreases the speed of the reel must increase to maintain a constant payoff rate. This means that the strip will tend to hang higher in the loop, as the coil diameter gets smaller. The drive must be sized to allow payoff at line speed, at the minimum coil diameter, and must also provide enough torque to accelerate the inertia of a full coil to line speed before the material stored in the loop is depleted.

Non-powered reels, also known as “pull off” reels usually have only a small fixed speed threading drive, or in some cases, may have no drive at all when used for small coils, or light gauge material. Pull off reels rely on a power straightener or a set of pinch rolls to pull the material off of the coil during automatic operation. The reel normally has a drag tensioning device of some sort to maintain back tension on the material and prevent slack from developing between the coil and pull off device during deceleration and stopping. If slack is allowed to develop it will result in marking and distortion of the material when, upon acceleration, that slack is taken up with a sudden jerk and the pull off rolls slip on the material.

In most applications a simple air or electric brake will suffice for this purpose provided it is able to dissipate the heat generated by the braking action and that the response and tension control is adequate. Air or water-cooling can be used to increase the thermal capacity of the brake and controls can be added to vary brake tension upon acceleration and deceleration. Although quite expensive, in high-speed applications where quick response and the ability to dissipate large amounts of heat are required a properly sized DC motor with blower cooling, speed feedback and special controls can be used to provide the braking action. Regardless of the type of braking used, the drag force must be considered when calculating the horsepower required for pull off.

Reels come in many different configurations, the most common of which is the single mandrel, cantilevered style. These are generally available in capacities from 500 lbs. up to 60,000 lbs. and in widths up to 78”. The weight and width limitation is due to the amount of weight that can be safely overhung on a single mandrel with that mandrel still able to fit into the inside diameter of a standard coil.

The most common range of coil inside diameters is from 16 to 24 inches. As the coil weight or material width increases the support bearings and mandrel diameter must be increased accordingly. At some point the size requirement becomes impractical for standard coils. Special materials and heat-treating can be used to minimize the mandrel diameter but these measures will add substantially to the cost.

The single mandrel cantilevered style reel is available in both stationary and traveling models. Whatever the method of unwinding, whether it be a cradle or a reel, the coil must always be centered to the press for proper operation. Misalignment of the coil causes binding throughout the feed line resulting in misfeeds and higher power consumption. The wider the material is the more critical centering becomes. Wide stock doesn’t like to bend sideways which is what will be required if the coil is not properly centered. For this reason when using a stationary horizontal reel it is important that the coil be precisely centered on the mandrel pads when it is loaded because it cannot easily be readjusted once it has been threaded. It is highly recommended that scales be provided on the mandrel pads for this purpose.

A traveling reel on the other hand allows the coil to be quickly repositioned in the event misalignment is detected. With a traveling reel the coil is always loaded against the back plate with the movable reel then being adjusted to center the coil to the press. If further readjustment for centering is required after threading it can be done easily by moving the reel again to center the coil. The ability to travel will add substantially to the price of the reel.

Another variation on the coil reel concept is known as a “double ended” version which features two mandrels facing in opposite directions with a rotating head. This style is ideal for quick coil changes. The empty mandrel can be re-loaded with a fresh coil while the other is running. When a coil change is required the head is rotated bringing the new coil quickly into position for threading which eliminates lost time in placing and centering a coil on the mandrel while the line sits idle. With the addition of dual hold down arms the double-ended reel is also ideal for running partial coils. A hold down arm is lowered onto the partially run coil to contain it, and it is indexed out of the way bringing the new coil into position so that it can be threaded immediately. The partial coil can then be re-banded and removed at your leisure while the new coil is running, thus eliminating down time. Double-ended reels are not generally available in traveling models for obvious reasons and are quite a bit more expensive than single ended units.

Dual cone or double stub arbor versions are yet another option that is generally used only for very wide coils, or heavy coils with small inside diameters which require support at both ends to prevent excessive mandrel deflection. With the double stub arbor style a mandrel is inserted into both ends of the coil for support with both assemblies having the ability to travel. This variety is normally quite expensive because in effect you are buying two complete traveling reel assemblies with stubby mandrels.

The third basic type of unwinder is known as the pallet decoiler or pan reel. This style is normally used only with narrow, light gauge materials. As the name suggests, with this method coils are laid on their sides and stacked on a pallet, which is then placed on a motorized turntable for unwinding. The top coil is run first and when it is complete the next coil in the stack can be immediately threaded without the need to actually load a coil.

Coils are run sequentially from top to bottom until all coils are depleted at which time a new pallet is loaded.

The range of width and thickness is limited due to the fact that the strip must make the transition from vertical to horizontal, as it is unwound. This reorientation requires much less space with narrow, light gauge material than it would with wide or heavy gauge material, which explains the strip size limitations inherent with this type of unwinder.

Some of the advantages of this style include its efficiency in terms of run time between reloading, minimal floor space requirement and a fairly low acquisition price. Because of the gauge range limitation the loop area is generally quite small and is normally contained above or around the coil. Since straightening cannot be done as a part of the unwinding process, pallet decoilers are often used in applications where straightening is not required, or in conjunction with a free standing powered straightener, or a pull through straightener at the feed.