Figure 1
Coil Turntable with Coil Saddles

COIL SLITTING IN A CHANGING MARKET

While the basic concepts of slitting haven't changed, they have surely evolved over the years, plus new and improved features have been incorporated into many of the newer slitting lines. Equipment builders continue to improve designs and add features reacting to the ever changing metals market. Today coils are larger than ever, sometimes more than 50 tons. Heavier gauges and higher strength materials must also be accommodated. Still others must contend with critical surfaces and the fact that while lighter gauges get lighter, they also seem to be trending toward softer materials. All of these changing conditions require special care and considerations when slitting. Modern slitters must be designed and built to accommodate these changing trends. This article will address just a few of the equipment concepts that are becoming more common to better serve today's metals market.

Coil Turntable with Coil Saddles

While 4-Arm Turnstiles are very common and an important ingredient to the efficiency of slitting lines, it is difficult to thread today's larger and heavier coils onto the awaiting arm using a crane and a C-Hook or Tong Type coil lifters. It is much easier to load these larger coils on to Saddles, thus eliminating the difficult threading. A Pit Type Coil Car would replace the more common floor level coil car. A downside of Coil Saddles, if they are located in a straight line, is that the coils must be loaded onto the coil car and uncoiler in the order of their saddle position.

The best of both worlds is adding a Turntable with Coil Saddles (**figure 1**) which provides the coil selection advantage of a turnstile, plus allowing for the quick and easy coil loading on to the Saddles. The use of Saddles eliminates the coil ID or weight limitations you have with turnstiles.

Figure 2
Dual Expanding Stub Uncoiler

Dual Uncoiler

Most commonly Uncoilers are the cantilevered type and allow for expansion to accommodate an ID range of 4" (i.e.: 20" ID to 24" ID coils). Due to the expansion limitations, filler segments are required for coils with larger ID's. The fillers available can be rubber, polyurethane, or steel, and may either be slide-on or a bolt-on type.

A Dual Uncoiler handles a large ID range without fillers. Effectively a Dual Uncoiler is two opposed

Uncoiler Drums. Both Drums are equipped with drag brakes and reversing jog drives. Dual Cone Uncoilers are two (2) opposing angle cone shaped mandrels that enter the coil ID, allowing it to handle a wide range of coil ID's. Because of the necessary pressure exerted to support the coil and provide adequate back tension, edge damage to the inner wraps of lighter gauge materials is not unusual.

An outgrowth of a dual cone uncoiler is a Dual Expanding Stub Uncoiler (**figure 2**). The dual expanding drums typically contain three (3) steps to accommodate an expansive ID range. Normally dual uncoilers are loaded with "pit-type" coil cars, but designs can also utilize "floor-level" coil cars.

Figure 3
Three Head Turret Slitter

Figure 4
Loop Control Pad Tensioner

Multi-Head Slitters

Initially all slitting lines were designed with a single fixed head slitter so production was halted while set-up changes were made online. The advent of multi-head slitters allowed the processor to make set-ups off-line while the line was running reducing the idle time to the time required to disconnect the drive, remove the online slitter head, replace it with the other slitter head, and re-connect the drive. While this is still a time consuming task, it is a dramatic improvement over a single fixed head slitter and online set-ups.

Finally, we came up with multi-head slitters that do not require disconnecting the drive and using a crane to transfer the slitter heads. Injector Head and Turret Head slitters were developed reducing the changeover time to only a minute or two, provided the tooling set-up was completed off-line. Now virtually all new slitting lines come with two (2) or three (3) heads, and more are possible.

Now that all set-ups are made offline the key to improving the efficiency of the set-up personnel is making their job easier by providing a clean, organized area for set-ups with access to the slitter heads. As slitter tooling becomes larger and heavier it becomes more difficult to load tooling from the side. A Turret Head Slitter (**figure 3**) addresses this concern by openly exposing the off-line arbors for easy access for tooling changes. In addition to Shimless Tooling, other features that further help to simplify the set-up changes are Threadless Hydraulic Arbor Locking Nuts as well as Pushbutton Lock-Up, which eliminates the need for locking nuts.

Loop-Control Tensioner

With ever increasing coil weights and more common thinner material thicknesses, looping pit depths of 30 feet or more have become normal. But, even so, these deep pits may not be deep enough for large, light gauge coils even with only the slightest thickness variation. Due to the crown of the strip, the center strips of a slit coil are thicker than the outside strips, so the center strips wind as larger diameter coils on the recoiler causing the outside strips to wind at a slower tangential speed.

Using conventional friction pads or tension rolls, traditional tension stands apply equal pressure across the entire width of all the slit strips and due to the slower speed of the outside strips, the outside strips will quickly reach the pit floor if the pit is not deep enough. With a Loop-Control Tensioner (**figure 4**), the pressure can be altered across the width in a number of individual zones. Start by applying equal pressure across all the strips, but as the coil runs the pressure on the outside zones is reduced to equalize the tangential speed of all slit strips. This will maximize the pit depth and keep the outside strips from "bottoming out", while all slit strips will wind tight with straight side walls.

Roll Tensioning

Because of the high cost of tension rolls, it is suggested that a less costly pad tensioner be used on all less critical surface materials and use a roll tensioner only for the most critical surface materials. When the need for roll tensioning exists, it is recommended that the slitting line

Figure 5
Duplex Roll Tensioner

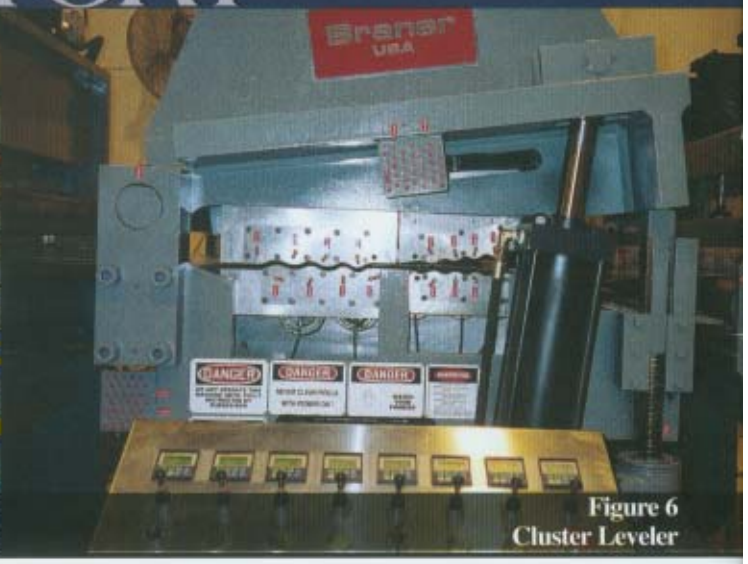

Figure 6
Cluster Leveler

also be equipped with a pad tensioner which enables the user to choose using the pads only, the rolls only, or a combination of both the pads and the rolls. While utilizing the pad tensioning is a simple task, utilizing the rolls only for proper tension requires special design and operator technique traits.

It is recommended that you use polyurethane coated rolls for critical dry materials and fabric rolls when running oily product. If you have a product mix that requires both polyurethane tension rolls and fabric rolls, a Duplex Roll Tensioner (**figure 5**) has two (2) sets of rolls. A set of poly rolls is mounted above a set of fabric rolls so the operator just chooses the appropriate set of rolls for the job and indexes accordingly.

Slitter Leveler

As we review critical materials, the wide gauge range and the various slit width requirements of coil processors, the "state-of-the-art" remains Loop Slitting. Some may suggest that the looping pit can be eliminated by adding a leveler to the slitting line, with the purpose of elongating the slit strips. Using Poisson's Ratio, we know a steel strip will change its dimension in a direction perpendicular to the applied stress, thus causing "necking", a reduction in strip width. Assuming you require a 25' deep pit, this means you need to stretch the material 50', which could cause some slit strips to "neck" considerably, making it impossible to determine the finished strip width. An engineering analysis can demonstrate what you can expect when stretching slit strips and the results are unacceptable, even if the requirements are less than commercial tolerances.

Is it possible to anticipate and build these tolerances into the set-up? No, this is impossible to do. While the operator can be slitting 20 cuts or even 30 or more cuts, how would he know which cuts to build extra width into, and how much? The amount needed to be built into the set-up could vary from one strip to the next, so what if you are slitting 10 cuts, 20 cuts, or 30 cuts? To further complicate the situation, what if the coil being slit was previously slit so the crown is not in the center? Necking the material to eliminate the looping pit in most cases is not a realistic solution. When you buy a new slitter, you spend a considerable amount of money for ultra precision slitter heads and than another considerable amount for precision tooling, why would you do this if you couldn't consistently hold tolerances of .002" or better?

Another significant disadvantage of using a leveler to eliminate the looping pit is because the material is being pulled under enormous tension at an angle, you will induce camber into the strip. For example, let's assume a 20 cut set-up using 1/8" thick separator discs, run with a centerline set-up you would be pulling the outside cuts on a bias of around 1 1/4" under considerable line tension. It's one thing to stretch material in a straight line, but how do you stretch slit mults at an angle without inducing camber? Also, keep in mind that a slitter containing a leveler without a tension stand is operating in the "pull-thru" mode. The use of a leveler with a limited correction capacity would always operate in the "pull-thru" mode on thicknesses heavier than the range of correction. A common work-roll diameter for a slitter leveler may be 1 3/4" so the leveler would not be engaged for thicknesses exceeding .134".

Now, all this is not to say that an in-line leveler cannot be an invaluable addition to a slitting line. For example a Cluster Leveler (**figure 6**) was designed specifically for use in coil-to-coil lines, primarily slitting lines, to improve the shape of the strip. The Cluster Leveler is a roller leveler designed to remove edge wave, center buckle, and cross-bow, plus it will roll-over burr from a poor set-up. The Leveler is designed to shape correct material with a wide range of thicknesses, but it is not promoted to stretch material to eliminate the looping pit (although this can be done) for the reasons described previously. Even with the addition of an in-line leveler, quality slitting still requires utilizing a tension stand and looping pit just like you do on a conventional, modern slitting line.

A Cluster Leveler is capable of eliminating strip shape defects such as center buckle, wavy edges, and cross-bow from the strip. The Cluster Leveler is a cor-

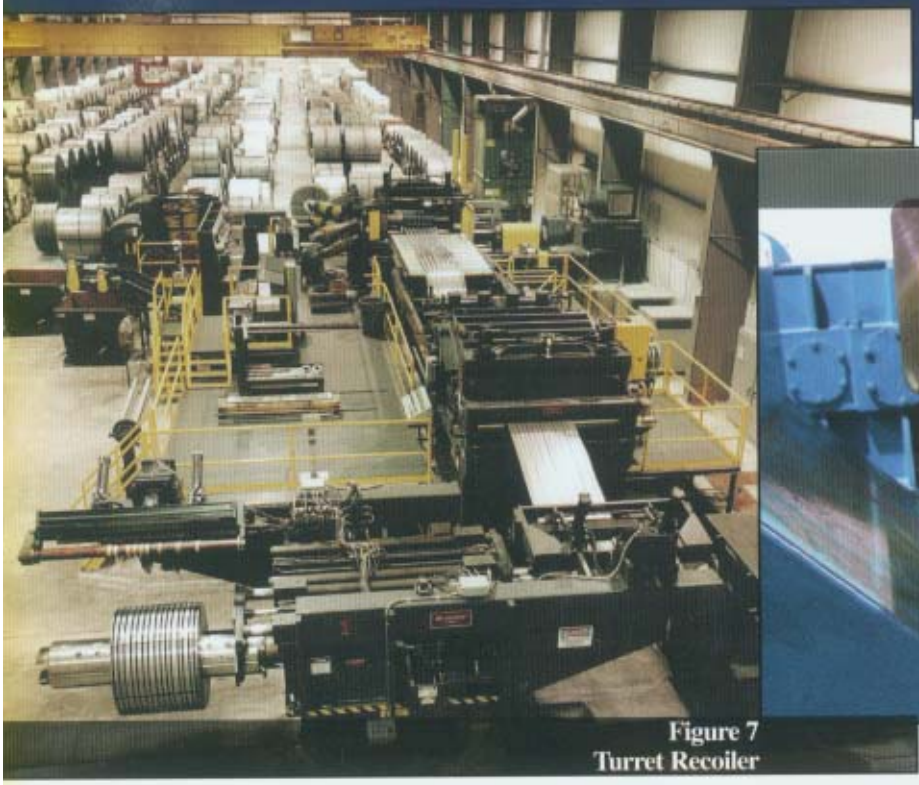

Figure 7
Turret Recoiler

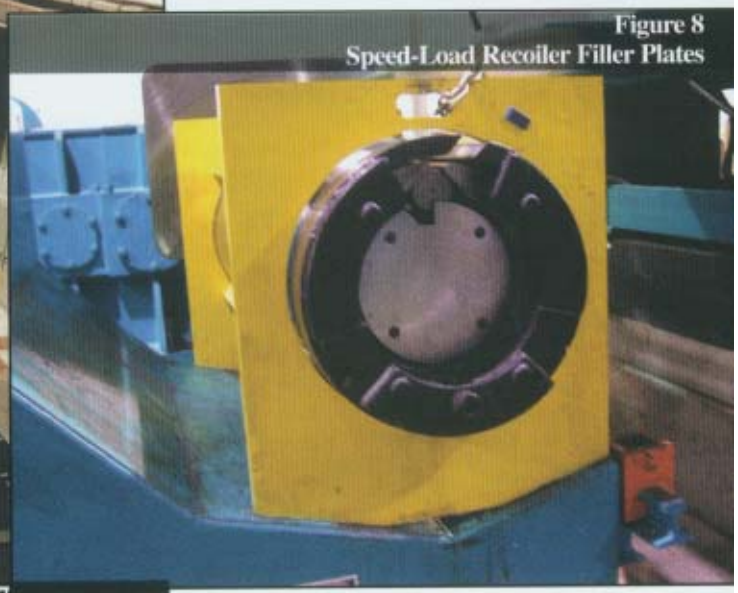

Figure 8
Speed-Load Recoiler Filler Plates

rective roller leveler with adjustable back-ups supporting work rolls that range in size from 3.000" to 1.500" diameter. The work roll design gives the Cluster Leveler the unique ability to eliminate strip shape defects from light gauges through .250" thick by applying large or small diameter work rolls to the strip depending on gauge and yield strength. A PLC eliminates leveler set-up trial and error time by making the set-up fully automatic. The operator enters the material thickness, yield strength and penetration mode from extra high to light into a data entry terminal. Once the parameters are entered, the controller adjusts the leveler for the material being processed. Back-up roll flights are adjustable at the data entry console located at the main operator desk or by joysticks mounted on the machine. Common set-ups can be saved in the controller for rapid recall.

Turret Recoiler

In order to address one of the most time-consuming tasks in a slitting operation, slit coil OD banding and preparation for coil unloading, the answer is a Turret Recoiler (**figure 7**) with two rewind drums and two overarm separators. After a coil is rewound, the drive disconnects from the rewind drum and the Recoiler rotates 180 degrees, positioning the finished coil at the unload station while positioning an empty drum at the slitting station. OD banding and coil unloading is accomplished while the strips are fed into and rewound on the opposite drum. Down time is virtually eliminated. To speed-up OD banding, both Overarms can be equipped with Tail Hold-Downs, a set of adjustable polyurethane pads that are pressed against the coil OD by hydraulic cylinders. The Tail Hold-Downs prevent the coil tails from clock-springing and provide a clear path for feeding the OD band around the coil. Each Turret Recoiler drum has an independent drive that allows the coil to be rotated at the unload station.

One-Minute Speed-Load Recoiler Filler Plates

Most service centers commonly produce 20" and 24" ID slit coils according to their customer's specifications. It is common knowledge that changing coil IDs can generate huge down time costs because switching from 20" to 24" or vice-versa requires "fillers' to be installed and removed from the Recoiler drum, and attaching or removing Recoiler fillers will typically waste 15-20 minutes of production time. A time-saving solution is to equip your line with "One-Minute Speed-Load Filler Plates" (**figure 8**) that switch coil IDs from 20" to 24" in one-minute. Unlike the more common "filler plates" that are comprised of three (3) or four (4) individual segments that are secured to the Recoiler drum with 4-6 bolts per segment; the Speed-Load Filler is a one-piece assembly that uses no Recoiler drum attachment bolts. Using the coil car to support and carry the holding fixture the Speed-Load Fillers assembly is slipped on the Recoiler drum to produce 24" ID coils, and slipped off the drum to produce 20" ID coils. Each cycle takes one-minute instead of 15-20 minutes, allowing the user to change the coil ID with no down time.

While each of the features highlighted in this article are designed to help you improve the job of quality slitting and quickly transfer to the "bottom line", the most important ingredient remains the quality of the personnel entrusted with the operation of your slitting line. We can't emphasize enough the importance of adequate and proper training, including safety training, for your slitter crew and supervisors. While we wouldn't let just anyone drive our $20,000 car unless we were confident they are qualified, why would we let someone with less than superb training and skills operate a slitting line that is valued in the $$$ millions? The quality of your operation is defined by the quality of your personnel.