APPARATUS FOR REMOVING THE CURL FROM SHEETS

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This invention relates to apparatus for removing curl from sheets, particularly metal foil and metal foil laminated sheets.

Metal foil and metal foil laminated sheets are ductile and possess dead-bending characteristics with the result that they are difficult to handle in printing presses because of their tendency to curl. In printing presses of the type in which sheets travel in contact with a rotary cylinder of the press, a curl is imparted to the sheets by the curvature of the cylinder, the curl being greater for cylinders of smaller diameter. A curl is also imparted to the sheets as they are stripped from the inked surface of the printing press. The tackiness of the ink tends to cause the sheets to cling to the inked surface beyond the line of tangency between the cylinders of the printing couple with the result that the sheets break away from the cylinder in a small radius, thereby rolling a curl in the sheets. The tackier the ink and the more solid the lay, the greater will be the tendency of the sheet to adhere to the inked surface.

Moreover, the tendency of the printed side of the sheet to adhere to the inked surface of the cylinder will impart a curl in the sheet. The more tacky the ink and the more solid the lay, the greater will be the tendency of the sheet to adhere to the inked surface. The path of travel of a sheet through the printing couple is shown in somewhat exaggerated manner in FIGURE 1 to illustrate the tendency of the sheets to cling to the inked surface of the cylinder and to break away therefrom in a small radius. A sheet printed in this manner, particularly a metal foil or metal laminated sheet, will curl and roll up upon itself as soon as it comes out of contact with the cylinder.

According to the present invention, the sheet is fed to the grippers 12 of the cylinder 10 and delivered to one of the grippers 14 carried by an endless conveyor chain 15 which travels around the sprockets or pulleys 16 and 16'. In transferring from the grippers 12 to the grippers 14, the leading edge of a sheet is engaged by the grippers 14 before it is released by the grippers 12, so that the leading edge of the sheet is continuously and positively fed from the printing press to the conveyor chain. A sheet transferred to the grippers 14 is carried along the lower span of the conveyor chain across a reverse-bending suction trough, generally designated 17, and ultimately delivered to a delivery stack 18. A curled sheet not subjected to the action of the reverse-bending suction trough is shown in broken lines in FIGURE 1.

The reverse-bending suction trough is shown more clearly in FIGURE 4 of the drawing. This trough includes a gently curved convex surface 19 on the upstream side of a center slot 20 and a gently curved convex surface 21 on the downstream side of the slot. The slot 20 is in communication with a suction pump or other source of vacuum through a suction conduit 22. The contour of the surfaces 19 and 21 is designed so that the surfaces will not have any substantial bending effect on the sheet.

However, the radius of a curvature a of the sheet as it travels across the slot 20 imparts a reverse-bending action on the sheet which effectively removes the curl from the sheet. Different degrees of de-curling action are obtained by regulating the amount of the vacuum which, of course, determines the radius of curvature a by pulling the sheet more or less deeply into the slot 20. Inasmuch as the printed surface f of the sheet is face up, the reverse-bending suction trough 17 will not smear the fresh printed sheet.

A modified form of reverse-bending suction trough 17 is illustrated in FIGURE 3 of the drawing. In this embodiment, rotating perforated rollers 25 and 26 are stationed side-by-side, and they are rotatably mounted about the stationary inner sleeves 27 and 28 as the sheets are drawn across the tops thereof. The inner sleeves 27 and 28 are provided with longitudinal slots 29 and 30, respectively, which slots face upwardly toward the relatively small gap between the perforated rollers 25 and 26. Each of the sleeves is closed at one end and the opposite end is in communication with a suction line so that the perforations of the cylinders 25 and 26, as they pass into registry with the slots 29 and 30 of the sleeves 27 and...
28, respectively, tend to draw the portion of the sheet passing above the perforated rollers into the gap therebetween, thereby forming the radius of curvature a. Thus, the reverse-bending effect produced is the same as described above with the reverse-bending trough shown in FIGURE 3.

The reverse-bending troughs described above can be arranged at right angles to the path of travel of the sheet or on a diagonal, as shown in FIGURE 4, to change or control curl in a cross-grain direction.

As explained above, the rotary printing press shown in FIGURE 1 is for illustrative purposes only, and obviously the present invention is usable in conjunction with other types of printing presses, including direct and offset presses, as well as rotary and flat-bed type presses. Also, while the invention has been described with particular emphasis on de-curling metal foil and metal laminated sheets, the de-curling apparatus of the present invention is also useful for removing the curl from paper sheets. For example, in offset printing presses, the moisture from the plate migrates through the paper stock. This moisture tends to relieve stresses in the paper stock which have been built into the stock for increased strength, and relieving these stresses causes the sheet to curl. This curl, however, can be eliminated by the apparatus described above.

The invention has been shown in preferred forms and by way of example only, and obviously many variations and modifications may be made therein without departing from the spirit of the invention. The invention, therefore, is not to be limited to any specified form or embodiment, except insofar as such limitations are set forth in the claims.

1. Apparatus for removing curl from sheets comprising means for gripping the leading edge of a sheet, an open reverse-bending suction trough extending transversely of said sheet and wide enough to insure that a portion of said sheet will be drawn into the trough to impart a reverse curvature thereto while said portion of the sheet is within the trough, and means for producing continuous relative movement between the gripping means and the reverse-bending suction trough to draw the sheet progressively across the trough from the leading end of the sheet to the trailing end thereof.

2. Apparatus as set forth in claim 1 in which the reverse-bending suction trough includes a transverse gap defined between a pair of sheet supporting surfaces, and passage means for bringing said gap into communication with a source of suction to draw a portion of said sheet into the gap.

3. Apparatus as set forth in claim 1 in which the reverse-bending suction trough includes a pair of sheet supporting surfaces defining an elongated slot therebetween, and a conduit establishing communication between said slot and a source of suction.

4. Apparatus as set forth in claim 1 in which the reverse-bending suction trough includes a pair of perforated rollers spaced apart side by side to form a gap therebetween, a conduit within each of said perforated rollers, each of said conduits being in communication with a source of suction and having an elongated slot directed upwardly and toward the gap between the rollers, the suction drawing a portion of the sheet into the gap between the rollers and the sheet imparting rotation to the rollers as it is moved relatively thereto.

5. Apparatus for removing the curl from sheets comprising an open reverse-bending suction trough having a recess therein defined between a pair of sheet supporting surfaces, passage means establishing communication between said recess and a source of suction, means for gripping the leading edge of a curled sheet, and means for imparting continuous translation to said grippers to draw the sheet progressively across the gap of the reverse-bending suction trough from the leading end of the sheet to the trailing end thereof, the reverse-bending suction trough extending transversely to the path of travel of the sheet.

6. Apparatus for removing the curl from sheets as set forth in claim 5 in which the means for imparting translation to the gripper means includes an endless conveyor which transports the gripping means in an orbital path.

7. Apparatus for removing the curl from sheets as set forth in claim 5 in which the sheet supporting surfaces of the reverse-bending suction trough are convexly curved and in which the recess is an elongated slot between the convexly curved surfaces.

8. Apparatus for removing the curl from sheets as set forth in claim 5 in which the sheet supporting surfaces are perforated rollers and the recess a gap between the perforated rollers, the sheet imparting rotation to the rollers as it is drawn across them.

9. In a sheet handling apparatus, a cylinder around which sheets are fed and which imparts a curvature to the sheets, means defining an open trough extending transversely of the path which the sheets follow when they leave the cylinder, suction producing means communicating with the open trough to draw into the open trough that portion of a sheet above it, and sheet feeding means for advancing a sheet continuously from the cylinder and across the trough defining means.

10. In the apparatus set forth in claim 9, a sheet feeding means which includes grippers for engaging the leading edge of the sheet, leaving the trailing edge free.

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