Jan. 30, 1962 E. J. MIKSIS 3,019,014

FOLDING ROLL

Filed March 20, 1961

Fig. 1

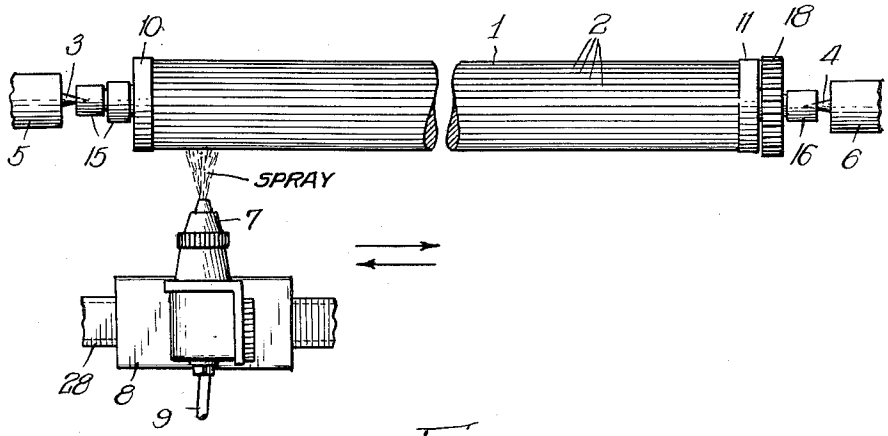


Fig. 2

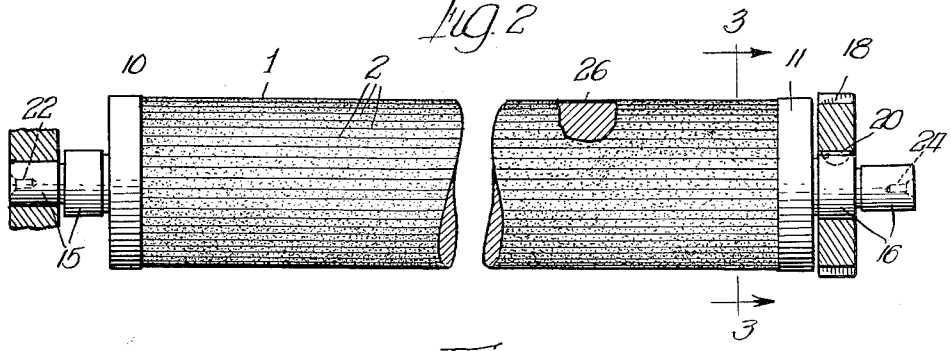
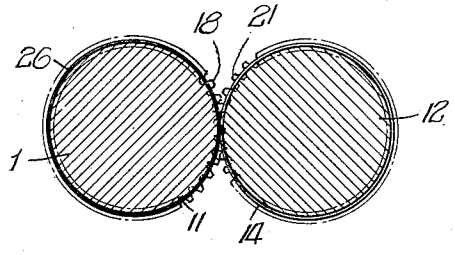


Fig. 3



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United States Patent Office 3,019,014 Patented Jan. 30, 1962

3,019,014

FOLDING ROLL

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Filed Mar. 20, 1961, Ser. No. 96,889
8 Claims. (Cl. 270—61)

This invention relates to folding rolls for folding machines for folding paper and other materials.

In one illustrative form of folding machine, sheets of paper, which may have printing or impressions with ink thereon, are fed from a stock table to a feed table which passes them to folding rolls. The rolls of a sliding carriage then pass the folded sheets to a second set of folding rolls, or to a stacker.

Slippage of the paper in the folding operation of the folding rolls has presented a difficult practical problem. Printing on the paper and enamels, or other materials in the ink, tend to increase this slippage. As a result, the paper slips sidewise when folded and the sheets do not register properly after folding.

Heretofore, it has been endeavored to meet this problem by knurling the surface of the folding roll with a view to obtaining a better gripping action on the paper and reducing slippage. These knurled surfaces wear off in use and do not grip the paper sufficiently, particularly relatively heavy paper, or paper with ink thereon, at high speeds. As a result the slippage problem has not been overcome and it has been necessary to slow down the machine because of the slippage of the paper.

The broad concept of the present invention resides in the provision of a folding roll having a surface coating of a hard surface roughening material spray-deposited and bonded to its outer surface and presenting a hard-wearing surface with sufficient roughness uniformly and continuously over the entire paper gripping surface of the roll to prevent slippage of the paper with which the roll is used.

More particularly, according to the present invention, the roll is pre-heated to from about 200° F. to about 300° F., and is rotated in a lathe, and the rotating surface, which is preferably knurled, is sprayed preferably with pure molybdenum, although other materials are contemplated as will hereinafter appear, which bonds to the knurled surface of the roll and presents a hard-wearing surface with sufficient roughness to prevent slippage of the paper with which the roll is used for folding the same.

Still more particularly, the pre-heated roll is mounted and rotated about a horizontal axis in a lathe, and, for example, rods of pure molybdenum are fed through a spraying device using oxygen, acetylene and air. The spraying device is mounted on the carriage of the lathe for movement longitudinally on the roll, and, as will hereinafter appear, the revolutions per minute of the roll and the speed of traverse of the metallizing gun are carefully correlated to obtain the desired results.

Folding rolls of the character with which the present invention is concerned usually have smooth annular bands at opposite ends of the paper gripping surfaces of the rolls and the paper gripping surfaces are of slightly less diameter than these end bands, for example, of a diameter about .001 inch less than the diameter of the end bands. According to the present invention the surface coating is spray-deposited over not only all of the paper gripping surface of the roll, but also over all of the circumferential surfaces of the end bands in order to maintain the desired relative diameters of the paper gripping surface and the end band surfaces of the rolls.

Further features and numerous advantages and adaptations of the invention will be apparent from the following detailed description taken in connection with the accompanying drawing, it being understood that the invention is limited only within the scope of the appended claims and not to the particular embodiment selected for illustration.

In the drawings:

FIGURE 1 is a top plan view showing diagrammatically a folding roll with a knurled surface held for rotation about a horizontal axis in a lathe and the spraying gun or device mounted on the carriage of the lathe for movement longitudinally along the roll in a path spaced laterally from the roll;

FIGURE 2 is a side elevational view, partially in section, of an improved folding roll according to the present invention; and

FIGURE 3 is a sectional view taken along the line 3—3 of FIGURE 2 and showing the roll of FIGURE 2 coacting with another folding roll.

Referring now to the drawing, the roll **1**, as shown in FIGURE 1, may, for example, be a conventional folding roll. These rolls are solid rolls and are usually formed out of ordinary steel, or the like. They vary in diameter from about 1½ inches to about 1¾ inches and in length from about 9½ inches to about 47 inches. These dimensions are merely illustrative and it is to be understood that the rolls may be of other diameters and lengths as desired.

Where the roll **1** has been in service with the shortcomings previously set forth, its surface is usually knurled. The knurling is shown in the form of longitudinal ridges or grooves **2** in the paper gripping surface of the roll **1**, but the knurling may be helical or of other form as desired.

According to the present invention, where the roll **1** with the gripping surface thereof knurled at **2** has been in service, it is first degreased and treated with a grit blast (slag grit) to roughen and clean the same.

The roll **1** is then pre-heated to from about 200° F. to about 300° F. The pre-heated roll **1** is then held between centers **3** and **4** in the headstock and tailstock **5** and **6** of a lathe and is rotated about a horizontal axis. The rotating surface of the heated roll is sprayed with a hard surface roughening material from a spray gun or spraying device **7** mounted on the carriage **8** of the lathe and movable therewith longitudinally along the roll **1** in a path spaced laterally from the roll. The arrows in FIGURE 1 indicate the directions of movement of the spraying device **7**. The spraying device is guided, for example, by a guide **28**.

The hard surface roughening material is thus spray-deposited and heat bonded to the material gripping surface of the roll **1** and presents a hard-wearing surface with sufficient roughness uniformly and continuously over the entire material gripping surface of the roll to prevent slippage of the paper or other material with which the roll is used for folding such paper or other material. The surface coating is not cut after application to produce an embossed pattern but, as set forth above and in the claims, is uniform and continuous over the entire outer roll surface which grips the paper or other material.

The spray is very fine, and is applied uniformly with high air pressure. For example, rods of pure molybdenum, one of which is shown at **9** in FIGURE 1, may be fed through the spraying device **7** which uses oxygen, acetylene and air.

While the use of pure molybdenum is preferable, the use of other hard metals, such as stainless steel, high carbon steel, or the like, is contemplated within the scope of the present invention. The use of alumina, or the ceramic materials is also contemplated.

The roll **1** has smooth bands or surfaces **10** or **11** integral therewith at opposite ends of the coated paper gripping surface of the roll. These bands **10** and **11** have smooth outer or circumferential surfaces and the coated paper gripping portion of the roll between the bands **10** and **11** is slightly less in diameter than the diameter of

the end bands **10** and **11**. As an example, the coated portion of the roll between the end bands **10** and **11** is of a diameter about .001 of an inch less than the diameter of the end bands.

As shown in FIGURE 3, the coated roll **1** coacts with a similarly formed and similarly coated roll **12** in the folding operation of the rolls. The rolls **1** and **12** are arranged with their axes parallel and with the slightly larger diameter bands **10** and **11** or roll **1** in engagement with the slightly larger bands **14** of the roll **12**. The spray-deposited surface coating is similarly applied to the end bands **10**, **11** and **14** of the rolls **1** and **12** and covers the circumferential surfaces of the end bands as well as the paper gripping portion of the roll. The coating over the end bands is of the same thickness as the coating over the paper gripping portion of the roll and in this way the desired relative diameters of the material gripping surfaces and the end band surfaces is maintained. As an example, the spray-deposited surface roughening coating **26** may be of a thickness from about .001 to about .003 of an inch.

The present invention, in its broader aspects, is not limited to coating the end bands as well as the paper gripping surfaces of the rolls to maintain the desired relative diameters of the material gripping surfaces and the end band surfaces of the rolls. Instead, only the paper gripping surfaces may be coated and the end bands may be formed of slightly larger diameter than the material gripping surfaces with the coatings thereon.

In applying the spray-deposited coating to the rolls, the revolutions per minute of the heated roll **1** and the speed of traverse or movement of the spray gun or spraying device **7** should be carefully correlated to obtain the desired results. For rolls having diameters of from about 1½ inches to about 1¾ inches, the roll **1** is rotated at about 210 r.p.m., and the spraying device **7** moves longitudinally along the roll at a speed of about .056 of an inch per revolution of the roll in the spray-depositing and heat bonding of the hard surface roughening material over the entire paper gripping surface of the roll.

The rolls **1** and **12** have integral reduced diameter axial extension **15** and **16** at opposite ends thereof. A gear or pinion **18** is keyed, splined or otherwise fixed at **20** on a portion of one of the extensions, for example, the extension **16**. This gear or pinion **18** meshes with a similar gear or pinion **21** similarly fixed on the adjacent extension portion of the roll **12**. A driving gear or pinion (not shown) meshes with one of the gears or pinions **18**, **21** to drive or rotate the rolls in unison.

The outer ends of the rolls have axial recesses shown in dotted lines at **22** and **24** in FIGURE 2 for receiving the centers **3** and **4** of the headstock and tailstock of the lathe in mounting the roll for rotation in the lathe.

With the spray-deposited and heat bonded hard surface roughening material on the paper gripping surfaces of the rolls and presenting hard-wearing surfaces of sufficient roughness and uniformly and continuously over the entire paper gripping surfaces of the rolls, it has been found that slippage of the paper, particularly sidewise in the folding operation is eliminated or reduced and that the folded sheets register properly after folding. These advantageous results are accomplished even with relatively heavy paper, or paper with ink thereon, at high speeds. As a result it is unnecessary to slow down the folding machine because of slippage of the paper or other material.

The embodiment of the invention disclosed in the drawing and specification is for illustrative purposes only, and it is to be expressly understood that said drawing and the specification are not to be construed as a definition of the limits or scope of the invention, reference being had to the appended claims for that purpose.

I claim:

1. In an apparatus for folding sheet material, a feed couple cooperating to feed said material, said couple including at least one roll, said roll comprising a rigid core having a folding portion provided with a cylindrical outer surface, and a molybdenum coating of substantially uniform thickness spray deposited over the outer cylindrical surface of the folding portion of the roll and forming an outer molybdenum material gripping surface over the outer surface of the folding portion of the roll, said outer molybdenum material gripping surface having a uniform and continuous roughening in all directions over the outer surface thereof and of a character incident solely to the spray deposit of said molybdenum coating over the outer cylindrical surface of the folding portion of the roll and without otherwise producing roughness in the outer coated surface of the roll, or grinding said outer coated surface.

2. A folding roll according to claim 1, wherein the molybdenum coating over the folding portion of the roll is of a substantially uniform thickness from about .001 of an inch to about .003 of an inch.

3. A folding roll according to claim 1, wherein the molybdenum roughened surface producing coating is heat bonded to the core of the roll.

4. A folding roll according to claim 1, wherein the core of the roll is formed of steel.

5. In an apparatus for folding sheet material, a feed couple cooperating to feed said material, said couple including at least one roll, said roll comprising a rigid core having a folding portion provided with a cylindrical outer surface, and a coating of substantially uniform thickness spray deposited over the outer cylindrical surface of the folding portion of the roll and forming an outer material gripping surface over the outer surface of the folding portion of the roll, said outer material gripping surface having a uniform and continuous roughening in all directions over the outer surface thereof and of a character incident solely to the spray deposit of said coating over the outer cylindrical surface of the folding portion of the roll and without otherwise producing roughness in the outer coated surface of the roll, or grinding said outer coated surface, or heat treating.

6. In an apparatus for folding sheet material, a pair of rolls cooperating to feed said material, at least one of said rolls comprising a rigid core having a folding portion provided with a cylindrical outer surface, and a molybdenum coating of substantially uniform thickness spray deposited over the outer cylindrical surface of the folding portion of the roll and forming an outer molybdenum material gripping surface over the outer surface of the folding portion of the roll, said outer molybdenum material gripping surface having a uniform and continuous roughening in all directions over the outer surface thereof and of a character incident solely to the spray deposit of said molybdenum coating over the outer cylindrical surface of the folding portion of the roll and without otherwise producing roughness in the outer coated surface of the roll, or grinding said outer coated surface.

7. In an apparatus for folding sheet material, a pair of rolls cooperating to feed said material, each of said rolls comprising a rigid core having a folding portion provided with a cylindrical outer surface, and a molybdenum coating of substantially uniform thickness spray deposited over the outer cylindrical surface of the folding portion of the roll and forming an outer molybdenum material gripping surface over the outer surface of the roll, said outer molybdenum material gripping surfaces having a uniform and continuous roughening in all directions over the outer surfaces thereof and of a character incident solely to the spray deposit of said molybdenum coatings over the outer cylindrical surfaces of the folding portions of the rolls and without otherwise producing roughness in the outer coated surfaces of the rolls, or grinding said outer coated surfaces.

8. Apparatus for folding sheet material according to claim 7, wherein there are cooperating cylindrical bands

at opposite ends of said folding portions of the rolls of diameters slightly greater than the diameters of the molybdenum coated portions of the rolls between said bands.

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