ROLL FOR CLEANING CONTINUOUS STRIP MATERIAL
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2 Sheets-Sheet 1


FIG-G
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## 2,929,088

## ROLE FOR CLEANING CONTINUOUS STRIP MATERIAL

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5 Claims. (Cl. 15-230)

This invention relates to cleaning and scrubbing rolls and more particuiarly to scrubber rolls used in the preparation of steel strip for tin-plating.

In tin-plating steel strip, the surface of the strip must first be clean and free of scale, grease and dirt. It is accordingly peckled and cleaned in a hot alkali solution and then rinsed in water, while it is at the same time scrubbed vigorously with power-driven rotary brushes. Heretofore, such brushes have been made of fibers, but difficulties have been encountered in their use. They rapidly lose their scrubbing efficisncy, because the fibers of the brushes absorb water and lose their stiffness and strength. The brush soon becomes matted down, further impairing its usefulness. Such brushes, therefore, require constant serviciag and frequent replacement.
The present invention provides a scrubbing brush comprising a roll having a plurality of segments, having circumferentially spaced, longitudinally extending rubber fingers which strike the strip forcibly with their leading edges, then scrub across the strip and finally leave the strip with a snapping action. Initial impact of the fingers loosens tightly adhering scale, dirt, and grease; the fingers then bend and their leading edges scrub across the strip; finally, the fingers leave the strip and return to their initial undeflected position, snapping away the dirt from the surface of the strip. This snapping action also results in the fingers being self-cleaning, an important practical consideration.
It is accordingly a general object of the invention to provide an efficient roll for cleaning the surfaces of continuous metal strip or other material.
A further object is to provide a scrubber roll having a plurality of resilient, flexible fingers adapted to clean initially by impact and then by a wiping and snapping action.
Another object is to provide a scrubber roll built up of sections which may be easily replaced.
Still other objects are to provide a scrubber roll having low initial cost, long life, high resistance to abrasion and chemical action and low maintenance and replacement cost.
Further objects and advantages of the invention will be apparent from the following description of a preferred form, reference being had to the drawings in which:

Figure 1 is a top plan view of the apparatus of the invention, showing the cleaning of a continuous metal strip just prior to a tin-plating operation;

Figure 2 is a side elevation of Figure 1;
Figure 3 is an enlarged fragmentary side elevational view showing the action of the fingers of the scrubbing rolls;

Figure 4 is a fragmentary sectional view of a roll of the invention taken substantially along lines 4-4 of Figure 2;
Figure 5 is a plan view of one of the sections of the scrubber roll;

Figure 6 is a fragmentary plan view of a modification of the invention;

Figure 7 is a fragmentary plan view of yet another modification of the invention;

Figure 8 is a somewhat diagrammatic view of another modification of the invention; and
Figure 9 is a plan view of yet another modification of the invention.

The scrubber roll of the present invention is described in connection with the cleaning of strip steel to prepare it for a subsequent plating operation, but it will be ap0 parent that the roll can be used for cleaning many other materials and types of surfaces with equal effectiveness. Such strip indicated at 10 in Figure 1 comprises long sections welded together as at 11 to form continuous lengths. The suiface of the strip often has tightly adhering scale, dirt and grease which is difficult to remove completely. Moreover, the strip at the weld area 11 has sharp edges and enlarged sections extending transversely across the strip, and the longitudinal edges 12 of the strip are not uniform, often presenting ragged cutting edges. Such material imposes severe demands upon any equapment which is used to clean it.
As the strip leaves the chemical cleaning baths, it is passed between a pair of scrubbing rolls 13 embodying the invention and simultaneously rinsed with cold water. Such rolls as shown in Figure 1 have a plurality of circumferentially spaced, longitudinally extending, radial fingers 14 of tough resilient material, preferably rubber of about 70 durometer. The sirip 10 as it enters the rolls is traveling at a speed of about 1750 feet per minute, and the rolls 13 are driven in the opposite direction at a peripheral speed of 2700 feet per minute, resulting in a net relative speed of 4450 feet per minute between the rolls and the strip.

As the strip reaches the bite of the rolls, the fingers 14 strike the stiip surface with considerable force, the impact of the fingers against the strip being confined to the sharp leading edges 15 of the fingers. After the initial impact, the fingers are deflected to assume the shape shown at $A$ in Figure 3 and they then scrub across the strip as shown at $B$, retaining this position until they move out of contact with the strip. Just as the fingers leave the strip, they snap forwardly, as indicated at C , into their initial undeflected position and in so doing throw the remaining dirt free of the strip, to be carried away by the rinse water. The action of the fingers thus consists of three steps, an initial impact by a sharp edge to loosen the dirt, a wiping action to scrape the strip clean, and a snapping action which throws the dirt off the strip. Any scale, dirt or grease pickedup by the fingers while scrubbing the strip will likewise be snapped free as the fingers leave the strip, and the fingers accordingly tend to be self-cleaning.

In the present example, the fingers have a length of about $15 / 6^{\prime \prime}$ and taper from a thickness of about $9 \%^{\prime \prime}$ at the euter ends to approximately $5 / 18^{\prime \prime}$ at their bases. The spacing between the teeth at their outer ends is about $5 / 6^{\prime \prime}$.

An important feature of the present invention is the provision of spaces 29 at the roots of the teeth, even when the pressure on the roll is great enough to close the space between the outer ends of the fingers. By providing a space approximately $1 / 16^{\prime \prime}$ wide at the base of the fingers, and extending radially outwardly a substantial distance, the roll will retain its resiliency under operating conditions. Thus, when a raised portion, as for example a weld, passes through the rolls, the fingers will have enough resiliency to adapt to the weld and retain their cleaning function.

Although the roll may be molded in one piece, a sectional construction as shown in Figure 4 is preferred.
Thus, as shown in Figure 4, the roll is made up of a plurality of longitudinal sections 16. Each section com-
prises a cylindrical body 17 integral with the fingers 14 and has a length of about $4^{\prime \prime}$ and an outside (finger-tip) diameter of $12^{\prime \prime}$ as seen in Figure 5. Each section is provided with four equally spaced holes 18. The body has a bore 19 of approximately $71 / 2^{\prime \prime}$, enabling the section to fit slidably over a metal tube 22, which is recessed internally at its ends, as at 23 . The length of the tube 22 is substantially equal to the total length of the sections to be placed thereon.
Metal aligning sleeves 24 are provided at each end of the tube; the sleeves have shoulders 25 adapted to fit snugly within the recesses 23 of the metal tube; in their flanges 26 are drilled four equally spaced holes 27 , which line up with the holes 18 in the sections. The sleeves have a longitudinally extending, central, hexagonal, opening 28, and two radial, opposite, threaded holes 29 fitted with set screws 30.
To assemble the roll, the necessary number of sections 16, usually $10-15$ in number, are placed end to end on the tube 22, with an aligning sleeve 24 at each end. The rods 34 having threaded ends 35 are passed through openings 27 and 18, and nuts 36 are threaded on and tightened. The unit is placed over a shaft of hexagonal cross-section 37 adapted to fit slidably within the corresponding openings 28 in the sleeves 24 , thus forming a concentric structure. The four set screws 30 are finally tightened onto the shaft, preventing axial movement of the unit, and completing the assembly.
In some cases, the sections may be bonded or otherwise fastened to cylindrical sleeves, which fit slidably over and are keyed directly onto a suitable shaft.
A modification of the invention is shown in Figure 6 , characterized by interlocking sections 40 which have longitudinally extending projections 4 l meshing with corresponding projections 41 of adjacent sections, locking the sections together so they rotate as a unit. If desired, the scrubbing fingers $\mathbf{4 2}$ may extend at an angle to the axis of rotation as shown in Figure 6.
In yet another modification of the invention, as shown in Figure 7, the roll is built up of sections 43 in which the fingers 44 of adjacent sections extend in different directions. The sections may also be so placed that the fingers extend in opposite directions from the central, axial plane of the roll. This arrangement of the fingers helps to center and guide the strip as it passes through the scrubbing rolls.

The modification shown in Figure 8 is useful in cleaning curved surfaces and comprises a roll in which the sections 45 present a curved configuration symmetrical about the axis of rotation of the roll.
The sectional roll construction has several advantages. For example, the sections of the roll which engage the edges of the strip are likely to be cut and abraded at a faster rate than the middle sections and to require more frequent replacement. An alternative is to mold such sections of a harder material than the middle sections. A sectional construction makes this possible. Furthermore, sectional construction makes it possible to lengthen or shorten the rolls for strips of varying width, thereby reducing equipment inventories.

In some cases, the noise generated by rolls having the fingers spaced equally about the roll circumference is objectionable, especially in high-speed cleaning. To reduce this noise, the roll may be divided into radial sec-
tions whose fingers have different spacings. The modification of Figure 9, for example, shows a roll divided into eight radial sectors, $\mathbf{5 0}, 51,5253,54,55,56,57$, each sector having 12 fingers. Sectors 50 and 54 are $38^{\circ} 15^{\prime}$; sectors 52 and 56 are $51^{\circ} 45^{\prime}$; and sectors 51, 53, 55 and 57 are $45^{\circ}$. Thus, a roll results in which the spacing between the fingers varies around the roll circumference. This is effective in minimizing noise of operation.

Another method of reducing noise is to offset adjacent roll sections circumferentially, whereby the regular fingerpattern is broken up.
While $I$ have shown in Figures 2 and 3 a pair of opposed scrubber rolls, it may be desirable to substitute for one scrubber roll a solid back-up roll turning in the same direction as the strip.
It is to be understood that the invention is not intended to be limited to the specife embodiments shown, and that various modifications will occur to those skilled in the art without departing from the spirit and scope of the invention, the essential features of which are summarized by the appended claims.

I claim:

1. A rotary rubber scrubber roll for cleaning a strip of rapidily moving steel after it leaves the cleaning bath and prior to a plating operation, comprising a plurality of adjoining, coaxial annular sections, each section comprising a plurality of circumferentially spaced, resilient fingers extending generally axially of said roll, said fingers protruding radially outwardly in medial planes passing through said fingers and the center of said roll, the bases of said fingers being wider than the space between them, the radial length of each said finger being such that its radially outer portion, after initial impact with said strip, deflects during scrubbing contact with said strip and derives support from engagement with the outer portion of an adjacent trailing finger, and each said deflected outer finger portion, after scrubbing said strip, returns from said deflected position into its original medial plane.
2. The roll of claim 1 and generally axially extending means for locking said sections together for rotation as a unit.
3. The roll of claim 2 and interlocking projections on said sections.
4. The roll of claim 1 , in which said fingers extend longitudinally at an angle to the axis of rotation of said roll.
5. The roll of claim 1 , in whic. 1 the spacing between adjacent fingers varies about the circumference of said roll.

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## CERTIFICATE OF CORRECTION

Patent No. 2, 929,088 March 22, 1960

Robert Wiere Jr.
It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column $3_{8}$ line 20 for "The" read -- Tie -- column $4_{8}$ line 37, for "said", second occurrence, read - its --i line 38 for "its" read -- said --.

Signed and sealed this 13 th day of September 1960.
(SEAL)
Attest:

KARL H. AXLINE
Attesting Officer

ROBERT C. WATSON
Commissioner of Patents

