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METHOD OF AND APPARATUS FOR DISPLACING CONTINUOUSLY
A FLEXIBLE BAND OF SOLID MATERIAL THROUGH
A LIQUID TREATING CHAMBER

2,651,104

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2 Sheets-Sheet 1

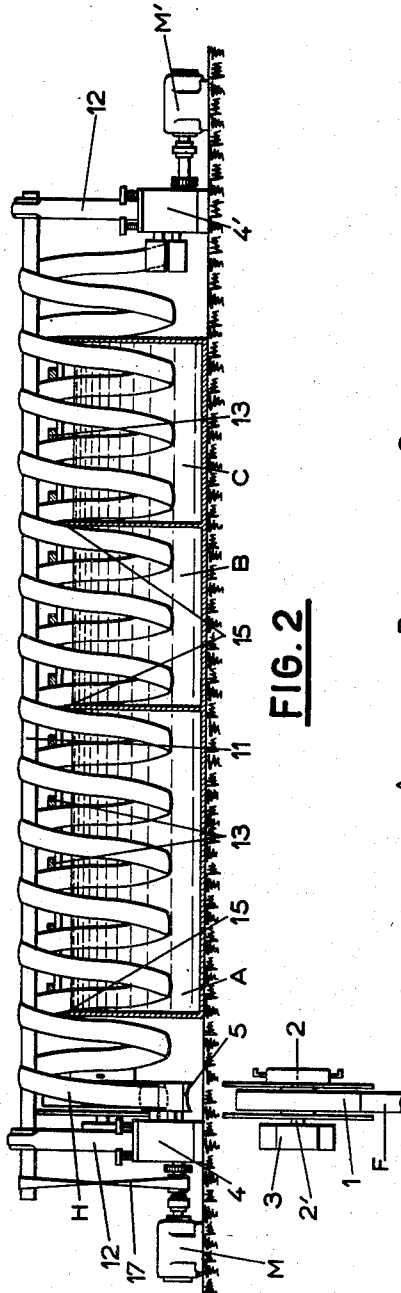


FIG. 2

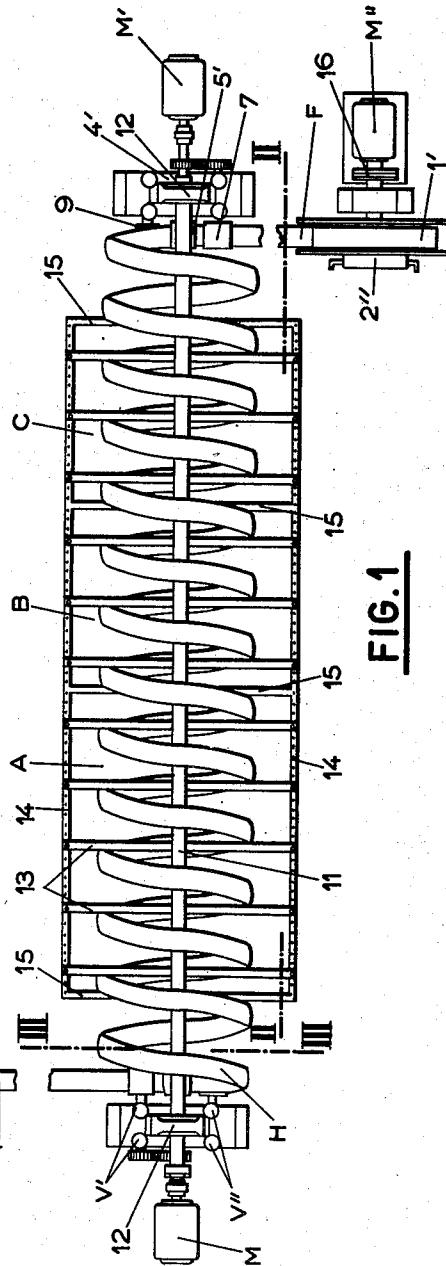


FIG. 1

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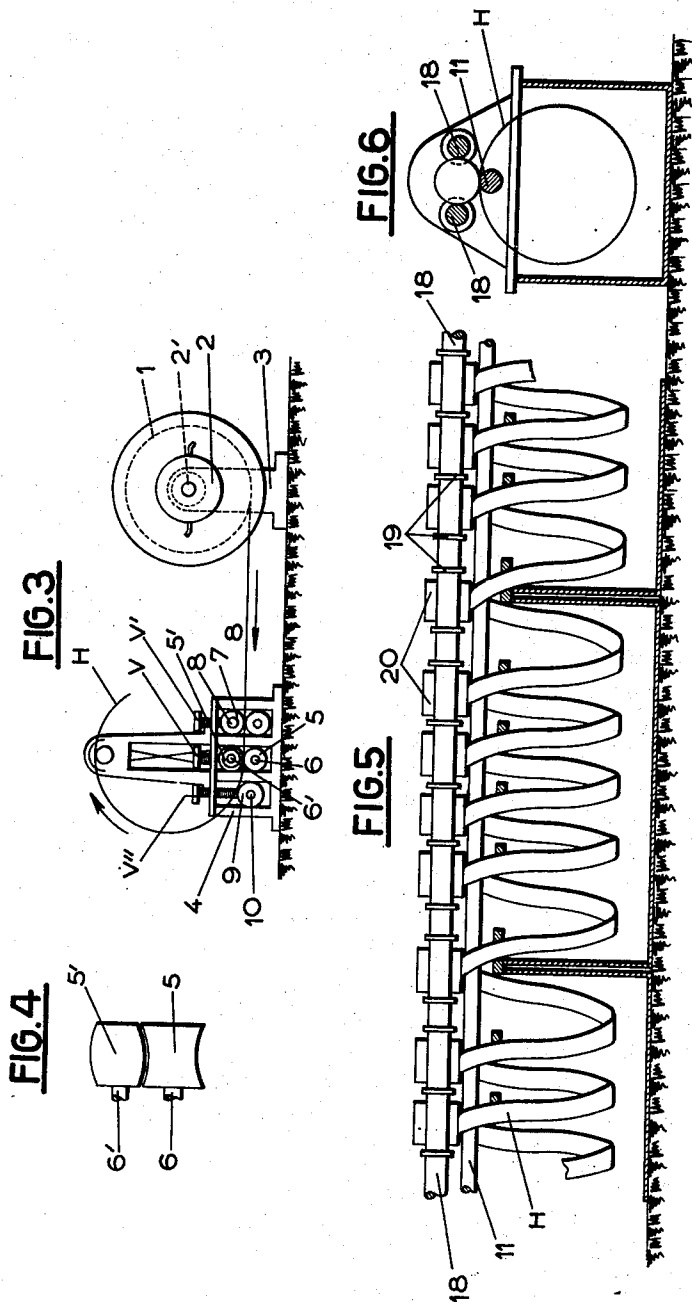
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UNITED STATES PATENT OFFICE

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METHOD OF AND APPARATUS FOR DIS-
PLACING CONTINUOUSLY A FLEXIBLE
BAND OF SOLID MATERIAL THROUGH A
LIQUID TREATING CHAMBER

Marcel Giros, Ancerville, France

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7 Claims. (Cl. 29—148)

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My present invention relates to a method of, and an apparatus for displacing continuously a flexible strip or band of a solid material through a treating chamber, and particularly to such method and apparatus adapted to the scaling of strip-iron.

An object of my invention is to provide an improved method of passing continuously a band having a considerable length through a treating tank or chamber of reduced size.

Another object of my invention is to provide an improved method of uncoiling automatically a strip or band from a reel to form an helix and of forcing the same through a treating tank or chamber.

A further object of my invention is to provide an apparatus for carrying my improved method into effect.

Yet another object is to provide an apparatus for carrying my improved method into effect, wherein the band is forced through treating baths or chambers out of contact with any supporting means in the bath.

In a number of industries, particularly the metallurgical industries, the raw materials used are half-finished products which are delivered in the form of flexible strips or bands or wires having a great length. In the present specification, the general term "band" will be used for indicating such a flexible strip or wire, whether plane and smooth or shaped in cross-section. It will be assumed further that the length of the band is considerable, and that the band, therefore, presents such a flexibility that it may be coiled around a support or present any other closed up or tightened form whereby its bulkiness is greatly reduced without affecting the qualities required from the material of which the band is made.

The closed up condition is favourable for storage, transport and handling purposes, but is detrimental when considering a number of treatments to which the metal may be subjected. For instance, it is difficult to carry out efficiently a surface treatment such as the scaling of strip-iron delivered in coils. In this case, the turns of the coil are joined and it is thus necessary to space apart the succeeding turns in order that the scaling solutions may pass therebetween to act on the surface of the band. In spite of the precautions taken for this purpose, such as corrugations in the turns or insertion of spacing members, etc., some turns remain closely engaged together, causing scale spots to remain present on the surface of the band, and such spots are detrimental for the further treatment of the metal.

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That is the reason why, whenever a perfect scaling is required in view of the further steps of treatment of the band (for instance rolling, manufacture of welded tubes, etc.), the strip-iron coil is uncoiled and then the uncoiled band is fed through the various treating baths along a substantially plane and linear path.

This process of continuous displacement of the band through the treating chambers or tank along a linear path presents however the drawback that it requires a considerable length for the treating installations and for the buildings enclosing such installations, as will be apparent from the following example:

Considering a scaling operation for instance and assuming that the metal must remain in contact with the liquid bath during 5 minutes time while the output rate must be 10 meters per minute, then it will be seen that the minimum length for the treating tank must be $5 \times 10 = 50$ meters. Due to this considerable length, such an installation is expensive, since it requires the use of tanks of special construction and of very large enclosing buildings for the tanks.

According to my invention, the closed up or coiled band is caused to uncoil and to be moved along a generally helical path within the treating zone, and then to be recoiled if desired. By "generally helical path" is intended any skew curve presenting a number of successive loops or turns and liable to present variable pitches and radii, such a spiral with a number of turns arranged substantially in a common plane.

By using my invention, a considerable reduction in the size and bulkiness of the treating installations may be obtained, as will appear from the following example, when assuming as in the first example that the band is to be immersed in a liquid bath for a period of 5 minutes with an output rate of 10 meters per minute. If we assume that the band follows a helical path, the pitch of which is .10 meter and the diameter 1.6 meter, and that at any moment two-thirds of the length of each helix turn are immersed into the treating liquid, then it is seen that for every meter of tank length the immersed length of band equals $3.14 \times 1.6 \times \frac{2}{3} \times 10 = 33.3$ meters substantially. Therefore, when using a tank having a length of 1.50 meter, the same result will be obtained as with the 50 meter tank referred to in the first example.

Other advantages are offered by the method according to my invention: due to the reduction in the tank length, the radiation and evaporation surfaces are reduced correspondingly and thus

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the thermal and evaporation losses in the treating bath are also reduced; moreover the insulation of the installation from the open air becomes many times easier.

On the other hand, in the particular case of strip-iron spirally arranged, a reduced force is required for driving the band; the driving mechanism may be made lighter thus reducing the power consumption with respect to the conventional case of a plane linear path. Further, the metal is subjected to a lesser deformation, that is to a lesser cold-rolling; moreover the feeding to and from the treating chamber or tank may be effected without any substantial deflection applied to the band, in contradistinction with the case of the conventional plane linear path for the band. Finally, it will be noted that the helical path causes the band direction of feed to be varied progressively only, generally resulting in a more regularly distributed action of the treating agents.

An apparatus according to my invention comprises in combination: means for uncoiling a band from a closed up or coiled condition; first driving means for the free end of said band, arranged upstreamly with respect to the treating tanks, as viewed in direction of displacement of the band; means for imparting a generally helical form to said band; supporting means out of contact with the liquid in the tanks for said helically formed band; second driving means for said helically formed band, out of contact with said liquid in said tanks; means for spacing apart the successive helical turns in said band; third driving means for the leading end of said band, arranged downstreamly with respect to said treating tanks; and means for closing up or recoiling said band after treatment.

My invention will be best understood from the following description of illustrative embodiments thereof, taken in connection with the annexed sheet drawings, wherein:

Figure 1 is a plane view of an apparatus for scaling steel strips;

Figure 2 is a vertical cross-sectional view taken along the line II—II of Fig. 1;

Figure 3 is an elevational view taken along the line III—III of Fig. 1, showing the input mechanism for feeding the band to be treated;

Figure 4 illustrates the form of the driving rollers in said input mechanism;

Figure 5 is a vertical cross-sectional view of a modification of the intermediary driving mechanism for the band along its helical path; and

Figure 6 is an end view of the arrangement of

Referring now to the drawings, the scaling apparatus for strip-iron conventionally comprises three treating tanks A, B, C containing an acid bath (sulphuric acid), an alkaline bath, such as a lime solution, and a washing bath, for instance water, respectively.

The coil 1 of strip-iron F is placed on a reel 2 adapted to rotate freely about a rod 2' supported in a frame 3.

An electrical motor M drives a pair of rollers 5—5' mounted in a frame 4 by means of a gearing mechanism enclosed in said frame 4. The rollers 5 and 5' are complementarily shaped in cross-section, as best shown in Fig. 4 and are carried from related shafts 6—6' arranged in a vertical plane and adapted to be shifted vertically in the frame 4.

A pair of cylindrical rollers 7 are mounted on respective shafts 8 slidably mounted in the

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frame 4; at least one of the rollers 7 is driven from the motor M, and the other roller 7 then may be mounted loosely about its supporting axis. A further roller 9 is mounted loosely on a shaft 10 vertically slidable in the frame 4.

The shafts 6' and 8 for the upper rollers 5' and 7 are mounted in carriages vertically slidable in the frame 4, said carriage being fixed to vertical threaded shafts screwed in the frame 4. Hand-wheels V and V' respectively are secured at the upper end of said threaded shafts, and the operation of the hand-wheels controls the tightening of the respective rollers against each other in the related sets of rollers. The position of the shaft 10 for the roller 9 is similarly controlled through a third handwheel V'', thus controlling the curvature of the helical loop H.

The assembly comprising the frame 4 and the associated mechanism is similar to the well-known type used for manufacturing mudguards and rims for bicycles. Thus the strip-iron F is caused to form an helical loop H which is stiffened by transversely cambering the strip-iron F under the action of the complementarily shaped rollers 5—5'. The helix H is supported at the upper portions thereof by a shaft 11 journaled in supports or uprights 12 arranged at either end of the tank assembly, respectively. The shaft 11 is driven rotatively with the same peripheral speed as that of the helix H supported therefrom.

Spaced bars 13 are arranged transversely above the treating tanks A, B and C, and are attached to the longitudinal upper edges 14 of said tanks. The bars 13 insure suitable spacing apart of the succeeding turns of the helix H. The top edges of the end walls of the tanks may be protected against wear by removable wear-bars 15.

When emerging from the last tank C, the strip-iron F is passed on a second roller 9 and then between further rollers 5—5' and 7 mounted in a receiving frame 4' similar to the feeding frame 4 and similarly controlled. Said rollers in the receiving frame 4' are driven from an electrical motor M'. The band is then directed to a receiving reel 2'' similar to the delivering reel 2; however the receiving reel 2'' is rotated by an electrical motor M''. 16 indicates a friction clutch enabling a constant tightness to be applied to the strip-iron F to coil the same on the reel 2''.

A single motor M may be used instead of the two motors M and M', when mechanically connecting the mechanisms in the frames 4 and 4'.

The shaft 11 may be driven by any convenient means, for instance through a belt 17 from the motor M since only a slight effort is transmitted thereby; indeed the rotational movement of the shaft 11 only avoids any detrimental friction, without having any substantial driving action on the helically formed band H.

The operation of the apparatus is as follows:

First, the roller 9 is adjusted vertically to give the desired curvature to the helix loop H, and the outer end of the strip-iron F is disengaged from the coil 1 and is passed between the rollers 7, and 5—5', respectively; then the motor M is started and the helix H begins to be formed. As the helix is fed through the tanks, the leading edge of said helix is introduced manually between the successive bars 13; this is possible, because the pitch of the helix may be changed in a narrower range, although the band presents a certain stiffness due to its cambering. Then the motor M' is started, and as the band emerges

from the last treating tank C, the leading edge of the band is introduced between the rollers in the receiving frame 4'. Finally the motors M and M' are stopped if necessary and the leading edge of the band is attached to the coiling drum supported on the reel 2'', and then the motors M, M' and M'' are started, thus producing the feeding of the band through the treating tanks and the coiling of the band on the reel 2''.

When the coil 1 is uncoiled completely from the delivering reel 2, the motors are stopped again, and a second coil of strip-iron may be mounted on the reel 2; the free outer end of said second coil is attached to the trailing edge of the preceding band by any convenient means. In this manner, the second band is fed through the treating tanks without it being necessary of guiding it through the tanks. When the trailing edge of the first band emerges from the last treating tank C, the motors are stopped, both bands are disengaged from each other and the first treated coil 1' is removed from the reel 2''. The same proceeding is followed for other succeeding bands.

Obviously, in some cases, it may be of interest that the band remains cambered after treatment; in such a case, the cross-sectional shape of the receiving rollers in the receiving frame 4' will be conveniently chosen to correspond with the cross-sectional shape of the band as emerging from the last treating tank. It is apparent also that the coiling of the band just treated may be dispensed with in some cases, if such a condition facilitates the further treatment of the band.

In a modification illustrated in Figs. 5 and 6, the band is not cambered in the feeding mechanism 4; in such a case, the shaped rollers 5-5' of the preceding embodiment are replaced by cylindrical rollers. In order that the band is fed through the treating baths, said band is driven by frictionally engaging the upper portions of the helix outside the treating baths. For this purpose, a pair of driving shafts 18 are arranged adjacent the shaft 11 and extend parallel to said shaft; the shafts 18 are driven in a direction reverse to that of the shaft 11, by any suitable means, such as gears. Both shafts 18 are provided with spaced flanges or rings 19 placed between the successive turns of the helix H. Rollers 20 are placed between the rings 19 and their longitudinal movement is limited thereby. The rollers 20 are resting on the shaft 11 and are applied against the upper portions of the helix H by gravity. The rollers 20 are rotated from the shafts 18 by frictional engagement, and are driven preferably with a peripheral speed slightly greater than that of the shaft 11, in order that the helix H be driven securely by frictional action, in spite of some sliding of the band with respect to the rollers 20, resulting from the frictional engagement.

It is to be understood that many changes and variations may be made to the above-described embodiments without departing from the scope of my invention. For instance, a cover made of a number of removable parts may be placed on the treating tanks, for the purpose of reducing the evaporation losses in the baths. Such a cover may be used simultaneously as a scraper member preventing the liquids of the baths to be taken off by the non-immersed portions of the helically formed band.

What I claim is:

1. A method of treating a flexible metal band in treating tanks comprising continuously helically pre-forming said band outside said treating tanks along a curved path, feeding continuously said helically pre-formed band through said treating tanks along a natural helical path of substantially constant curvature, supporting said band in said tanks at points above said treating tanks, and leading said helically formed band out of said treating tanks.

2. A method of treating a flexible metal band in treating tanks comprising continuously helically pre-forming said band outside said treating tanks along a curved path, feeding continuously said helically pre-formed band through said treating tanks along a natural helical path of substantially constant curvature, supporting said band in said tanks at points above said treating tanks, spacing apart the successive turns of said helically formed band in said treating tanks, and leading said helically formed band out of said treating tanks.

3. A method as in claim 2, further comprising coiling said helically formed band when treated.

4. A method as in claim 2, which comprises cambering the flexible band and simultaneously pre-forming the helix outside the treating tanks before said band is fed in said treating tanks.

5. An apparatus for treating a flexible metal band comprising: treating tanks, means located outside said treating tanks for continuously helically pre-forming a long flexible band, a horizontal rotative shaft situated above said tanks supporting said helical band in said treating tanks, a series of rollers placed in said horizontal supporting shaft and resting thereon, a pair of driving shafts extending longitudinally, in a parallel direction with said supporting shaft on either side thereof, and engaging frictionally said rollers for rotation, peripheral extensions on said driving shafts, substantially in the respective vertical planes of said transverse bars, loosely engaging the end faces of said rollers and limiting the axial displacement thereof, whereby said rollers frictionally drive said band passing between said rollers and said supporting shaft, and means also situated outside said treating tanks for leading said band out of said treating tanks.

6. An apparatus as in claim 5, wherein said last-mentioned rollers are caused to rotate with a peripheral speed greater than the speed of feed of said band.

7. An apparatus for treating a flexible metal band comprising: treating tanks, means located outside said treating tanks for continuously helically preforming a long flexible band, a horizontal rotative shaft situated above said tanks supporting said helical band in said treating tanks, and means, also situated outside said treating tanks, for leading said band out of said treating tanks and for coiling said band along a curved path.

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