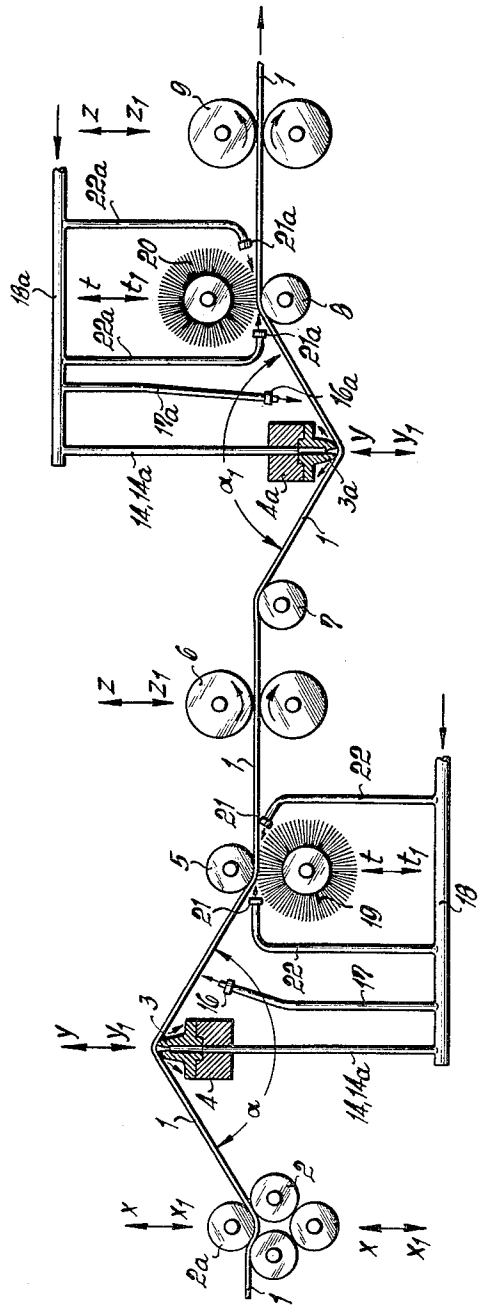
Oct. 5, 1965 R. AMTMANN 3,209,429

METHOD AND APPARATUS FOR DESCALING STRIP MATERIAL, ESPECIALLY STRIP IRON

Original Filed Feb. 17, 1958 6 Sheets-Sheet 1

FIG. 1



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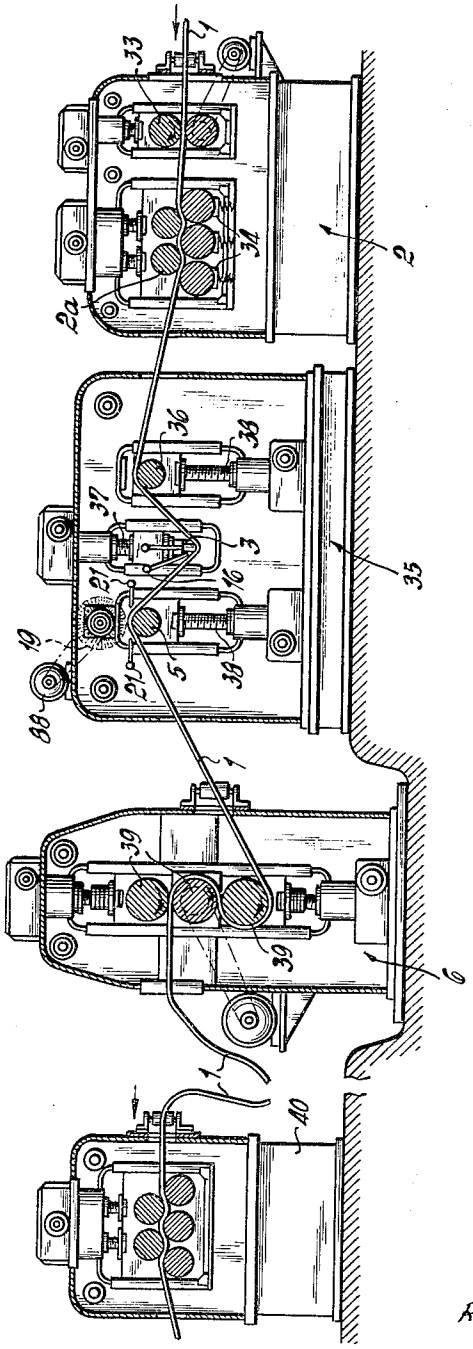
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Oct. 5, 1965 R. AMTMANN 3,209,429

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Original Filed Feb. 17, 1958 6 Sheets-Sheet 2

FIG. 2



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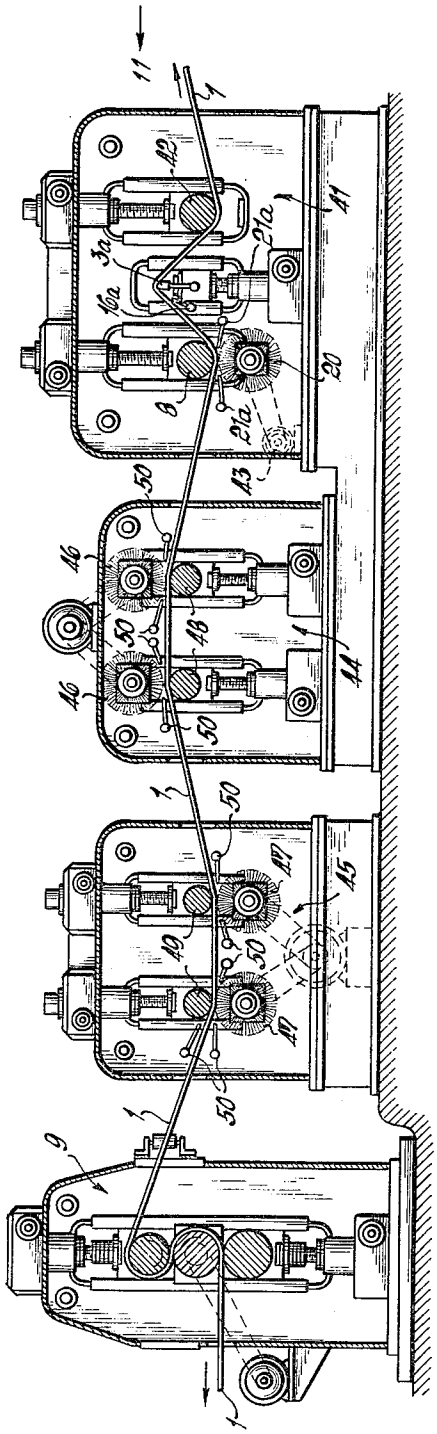
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METHOD AND APPARATUS FOR DESCALING STRIP MATERIAL, ESPECIALLY STRIP IRON

Original Filed Feb. 17, 1958 6 Sheets-Sheet 3

FIG. 3



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Oct. 5, 1965 R. AMTMANN 3,209,429
METHOD AND APPARATUS FOR DESCALING STRIP MATERIAL, ESPECIALLY STRIP IRON
Original Filed Feb. 17, 1958 6 Sheets-Sheet 4

FIG. 4

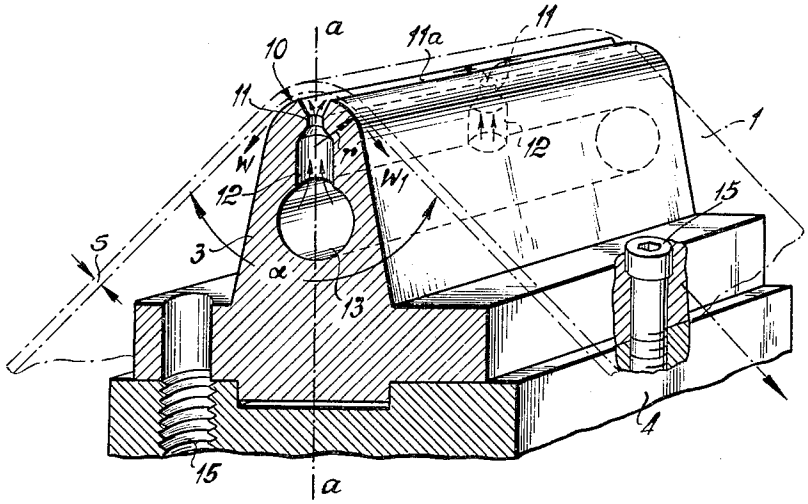
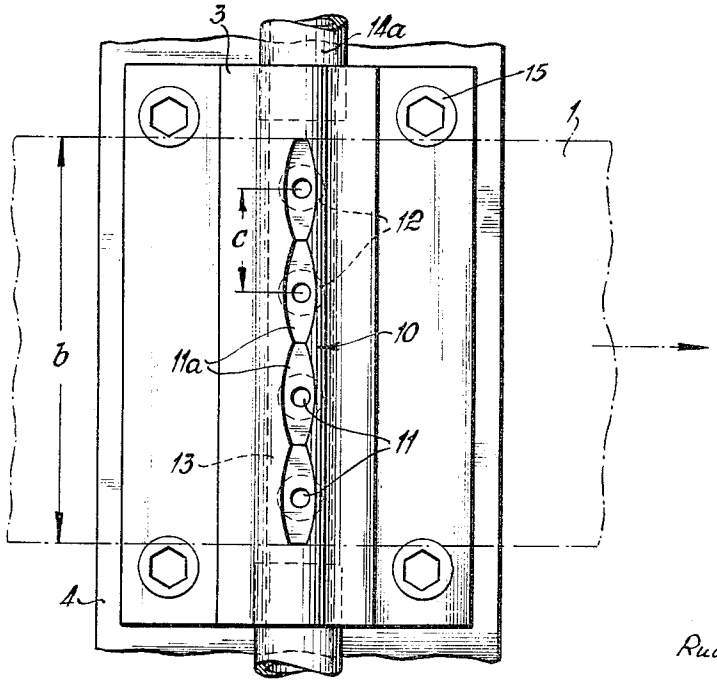


FIG. 5



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Oct. 5, 1965 R. AMTMANN 3,209,429
METHOD AND APPARATUS FOR DESCALING STRIP MATERIAL, ESPECIALLY STRIP IRON
Original Filed Feb. 17, 1958 6 Sheets-Sheet 5

FIG. 6

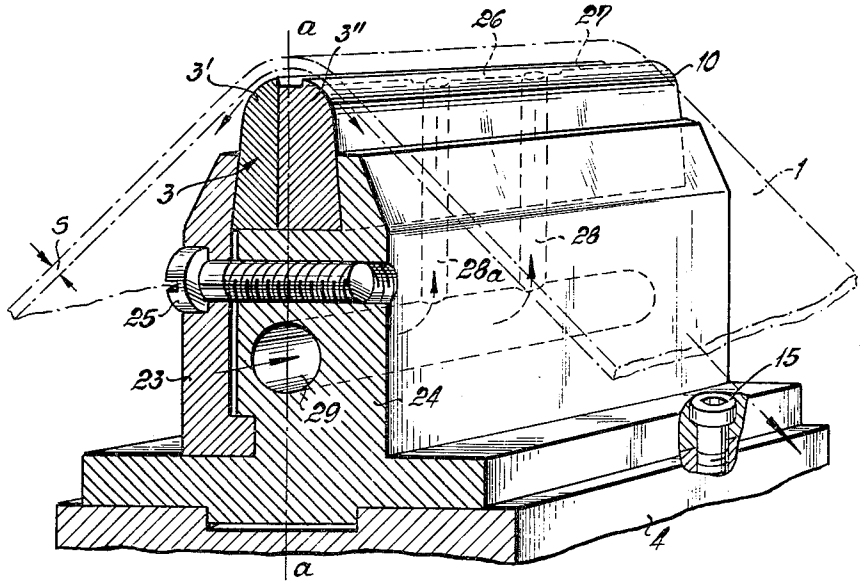
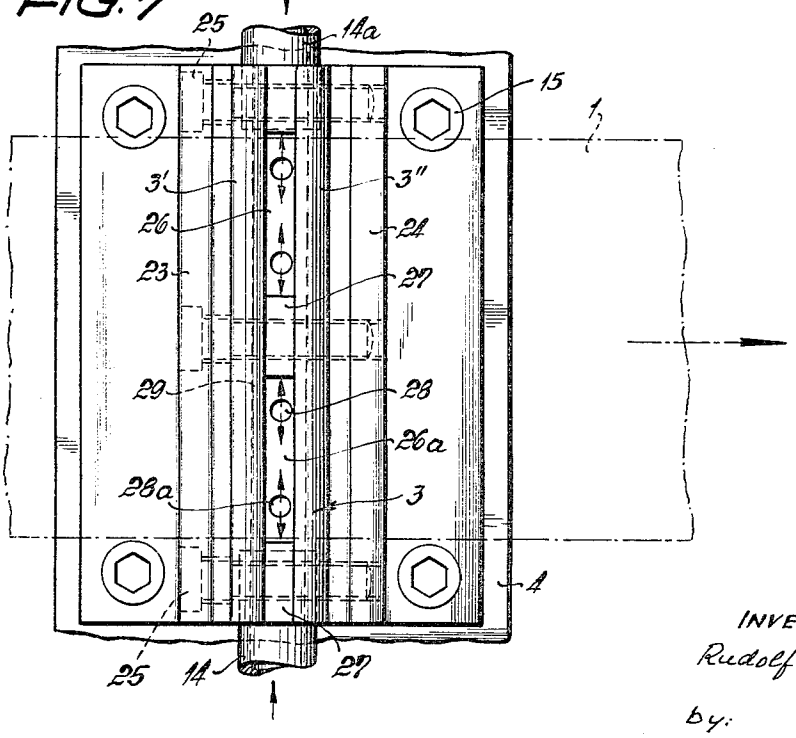


FIG. 7



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Oct. 5, 1965 R. AMTMANN 3,209,429
METHOD AND APPARATUS FOR DESCALING STRIP MATERIAL, ESPECIALLY STRIP IRON
Original Filed Feb. 17, 1958 6 Sheets-Sheet 6

Fig. 8

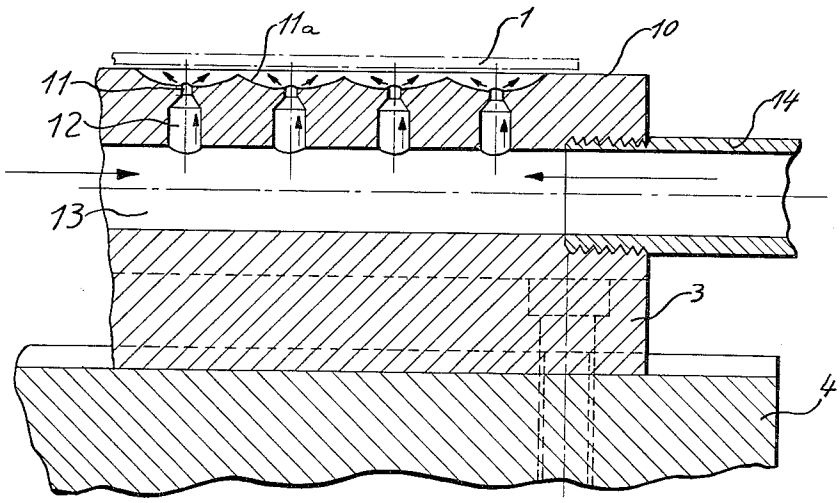
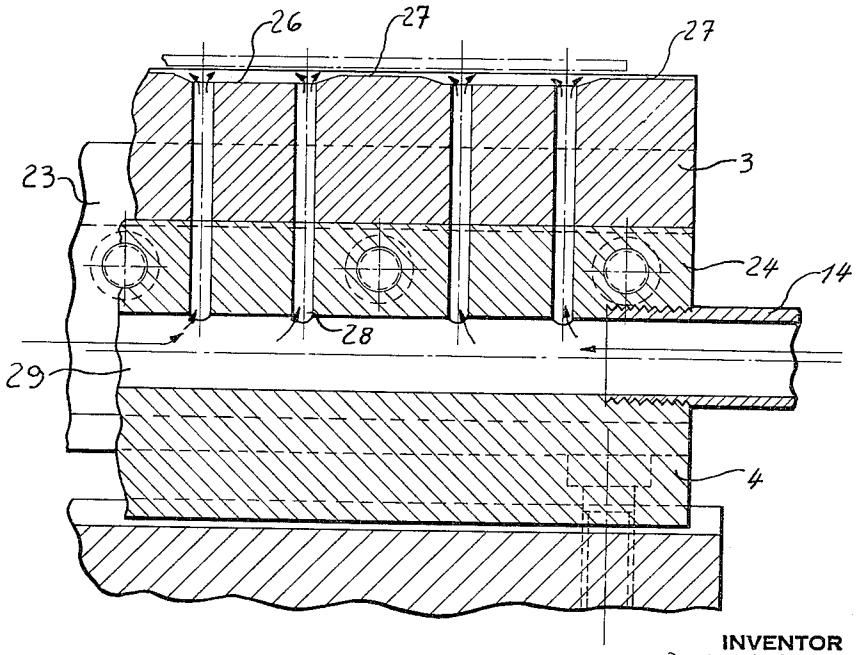


Fig. 9



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3,209,429

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3,209,429

METHOD AND APPARATUS FOR DESCALING STRIP MATERIAL, ESPECIALLY STRIP IRON

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Original application Feb. 17, 1958, Ser. No. 715,666, now Patent No. 3,054,162, dated Sept. 18, 1962. Divided and this application July 19, 1962, Ser. No. 210,953

Claims priority, application Germany, Feb. 16, 1957, M 33,268

5 Claims. (Cl. 29—81)

The present application is a divisional application of my copending application Serial No. 715,666 filed February 17, 1958, now Patent No. 3,054,162.

The invention relates to an apparatus for continuously descaling strip material and especially strip iron, in which the strip is drawn in zig-zag fashion over deflecting rollers and mutually displaced and adjustable metal guide bars with curved guide surfaces, and the scale is detached by the guide bars engaging in the vertex of a bending angle formed by the strip.

The invention is based on a former suggestion of the applicant, according to which the strip materials is drawn in zig-zag fashion over deflecting rollers and mutually displaced and adjustable metal guide bars with curved guide surfaces. The strip is passed over each guide bar at a bending angle which is preferably between 60 and 120°. The scale is thereby detached from the surface of the strip by the guide bar arranged in the vertex of the bending angle, a portion of crushed scale being drawn between the bar and the strip to serve as lubricant, for the subsequent removal of which brushes are provided.

An object of the present invention is to provide an apparatus for continuously descaling strip material, particularly strip iron, which comprises in the region of the curved guide surface of each guide bar at least one pastage extending substantially perpendicularly to the surface of the strip for feeding the pressure water between the guide bar and the surface of the strip. In order, particularly in the case of relatively wide strips, to obtain as far as possible a pressure water cushion of uniform configuration over the entire width of the strip, it is advisable to equip each guide bar with several feed passages distributed over its length, which passages are connected to a common feed conduit for the pressure water. The feed passages are preferably constructed as nozzles and arranged with their axes in the longitudinal central plane of the guide bar, so that the strip is flushed with water jets projected with great force, practically over its entire width, and the scale detached from the surface of the strip by bending the strip is flushed out of the pores of the strip and washed away. The mouths of the nozzles are preferably widened in fan-shape in the longitudinal direction of the guide bars so that, to obtain the same descaling effect, a smaller number of nozzles is required.

In another form of construction the apparatus according to the invention is provided with at least one elongated pressure water chamber extending in the longitudinal direction of the guide bar, which pressure water chamber is open toward the guide surface of the bar and connected to a pressure water feed conduit. In order to obtain a uniform distribution of pressure water on the entire width of the strip, it is preferable to provide several pressure water chambers arranged one behind the other in the longitudinal direction of each guide bar, which chambers extend over a considerable portion of the width of the strip and are connected by short connection passages to a distributor passage of relatively large cross section arranged under the guide bar and extending in the longitudinal direction thereof.

With the aid of the invention metal strips with a very

wide range of thicknesses, for example strip iron from about 0.5 to 10 and even more mms. in thickness can be descaled. The size of the bending angle depends upon the material and the thickness can be descaled. The size of the bending angle depends upon the material and the thickness of the strip, and also upon the thickness and composition of the layer of scale. In most cases the most favorable bending angle lies between about 60 and 120°, but deviations from these values are conceivable.

Several preferred embodiments of the invention are illustrated by way of example in the accompanying drawings, in which:

FIG. 1 is a diagram showing the general layout of a descaling apparatus according to the invention;

FIGS. 2 and 3 are vertical central sections showing the descaling apparatus in greater detail, FIG. 2 showing a first portion and FIG. 3 a section portion of the apparatus arranged at the left side of the portion shown in FIG. 2;

FIG. 4 is a cross section through a guide bar equipped with pressure water nozzles;

FIG. 5 is a top plan view of FIG. 4;

FIG. 6 is a cross section showing half of a modified guide bar equipped with pressure water chambers; and

FIG. 7 is a top plan view of the complete embodiment shown partly in FIG. 6.

FIGS. 7 and 8 are longitudinal cross sections through the bending devices shown in FIGS. 5 and 7 respectively and illustrate more clearly the arrangement of the mouth ends **11***a* of the nozzles shown in FIG. 5 and the grooves **26** and **27** in the bending device of FIG. 7.

Referring now more particularly to the drawings, FIG. 1 shows a descaling apparatus in which a strip of band iron **1** running off a reel, not shown in the drawings, is first passed through a braking device **2** composed of four mutually adjustable rollers. By adjustment of the rollers of the braking device **2** in the directions x–x_1 the tractional resistance of the strip can be regulated. A dressing or straightening mechanism which is not driven can, for example, also be used as braking device. An upper roller **2***a* of the braking device **2** serves at the same time as guiding and deflecting roller for the strip **1** which is subsequently passed in zig-zag fashion over a guide bar **3** which is detachably mounted on a carrier **4** adjustable in the directions y–y_1. The guide bar **3**, as can be seen from FIGS. 1 and 4, engages the surface of the strip in the vertex of the bending angle α formed by the strip **1**. The size of the bending angle α depends partly upon the material of the strip to be descaled, the thickness of the strip and also the composition and thickness of the scale layer and generally lies between 60 and 120° in the case of iron strip about 1 to 10 mms. in thickness. By adjustment of the carrier **4** in the directions y–y_1 the bending angle of the strip **1** can be adjusted within a range of, for example, about 60 to 150°. The bending angle α is changed when a strip of a different thickness and/or with a different scale composition is to be passed through the descaling apparatus.

Beyond the guide bar **3** engaging the under side of the strip in FIG. 1, the strip **1** is again deflected by a roller **5** and then runs through a pulling device **6**, which, in the example illustrated in FIG. 1, consists of two rollers at least one of which is driven and which are mutually adjustable in the directions z–z_1. By change of the spacing and the speed of rotation of the rollers mounted in the pulling device **6**, the tensional force imparted to the band **1** can be regulated. Beyond the pulling device **6**, the strip **1** is preferably guided over another deflecting roller **7** and subsequently over a second guide bar **3***a* displaced in relation thereto, which bar engages the upper side of the strip. By the guide bar **3***a* the strip **1** is bent in zig-zag fashion in the opposite direction, the bending angle α_1 formed at the guide bar **3***a* being of the same

dimension as the bending angle α at the guide bar **3**. The guide bar **3***a* is, just like the guide bar **3**, exchangeably mounted on a carrier **4***a* adjustable in the directions y–y_1. Beyond the guide bar **3***a* the strip is returned into the horizontal plane of travel of the strip by a deflecting roller **8** and subsequently runs through a second pulling device **9** which, like the pulling devices **6**, consists of rollers adjustable in relation to each other in the directions z–z_1, at least one of said rollers being driven at an adjustable speed of rotation.

In the descaling apparatus illustrated in FIGS. 2 and 3, the first guide bar **3**, contrary to the arrangement shown in FIG. 1, is arranged above the strip **1**, whereas the second guide bar **3***a* shown in FIG. 3 is below the strip. It is immaterial whether the arrangement according to FIG. 1 or that according to FIGS. 2 and 3 is chosen. As can be seen from FIG. 2 the strip **1**, in entering the apparatus, first passes between a pair of feed-in rollers **33**, at least one of which is driven. These feed-in rollers are followed by the rollers of the braking device **2**. In the present case five rollers are provided some of which are braked directly or on their ends. These rollers also serve for straightening the strip. Means for braking the rollers of the braking device are indicated at **34**. The braking force can be adjusted by spring pressure. The strip **1** passes from the braking device **2** into a first descaling unit **35** of the apparatus in which the strip is guided over rollers **36** and **5**. The guide bar **3** is arranged between these rollers **36** and **5** and is adjustable in vertical direction by means of a screw **37**. The rollers **36** and **5** can be adjusted in vertical direction with the aid of screws **38**. A rotary brush **19** is mounted above the roller **5** and driven by a motor **88**. After the removal of scale on one side of the strip **1**, the latter passes from the descaling unit **35** into the pulling device **6** which has driven rollers **39** around which the strip is passed so as to be pulled through the unit **35** against the resistance of the braking device **2**.

For descaling the other side of the strip **1**, the strip travels first through another braking device **40** following the pulling device **6** and corresponding substantially to the braking device **2**. As shown in FIG. 3, the strip **1** then enters a second descaling unit **41** of the apparatus in which the guide bar **3***a* is arranged. This guide bar **3***a* is located between guide rollers **42** and **8**. A rotary brush **20** is coordinated to the roller **8** and driven by a motor **43**. Two further units **44** and **45** are connected up in series beyond the second descaling unit **41**. The units **44** and **45** include driven brushes **46** and **47** which cooperate with adjustable guide rollers **48** and **49** respectively. Spraying devices **50** are provided for supplying water under sufficiently high pressure to each of the brushes **46** and **47**. These spraying devices can be coordinated to the upper and lower sides of the strip. Nozzles for spraying water under pressure are also coordinated to the already mentioned guide bars **3** and **3***a*. The special forms of construction and arrangement will be hereinafter described. Beyond the unit **45** the pulling device **9** is provided which corresponds in construction to the pulling device **6** of FIG. 2.

As can be seen from FIGS. 4 and 6, the guide bar **3** has a curved guide surface **10**. This guide surface **10** is cambered according to a radius r which is differently dimensioned in guide bars serving for descaling strips of different thicknesses. It has been found advantageous to make the radius r about four times as great as the actual thickness s of the strip.

In the form of construction of the descaling apparatus illustrated in FIGS. 4 and 5, the guide bar **3** and the similarly constructed guide bar **3***a* are provided with several nozzles or jets **11** arranged at regular intervals apart in the longitudinal direction of the bar, through which nozzles water under high pressure of about 30 to 100 atms. for example, can be fed between the guide surface **10** and the surface of the strip. The nozzles **11** are arranged with their axes in the longitudinal central plane *a*—*a* of the guide bar **3**. These nozzles **11** are connected by means of short passages **12** to a distributor passage **13** of relatively large cross section passing through the guide bar over its entire length and extending parallel to the guide surface **10**. The distributor passage **13** is, as can be seen from FIG. 5, connected at both ends to a feed conduit **14** and **14***a* respectively for the pressure water. The pressure water is fed to the guide bars **3**, **3***a* preferably by a high-pressure pump which is not shown on the drawings but which is so constructed that the pressure and quantity of the water fed can be regulated, preferably continuously, within wide limits. It is evident that it is also possible to provide for the regulation of the pressure and/or the quantity of water fed to the nozzles **11** of the guide bars **3**, **3***a*, throttle elements fitted in the feed conduit **14**, **14***a*.

As shown in FIG. 5, the nozzles **11** arranged one behind the other in the longitudinal direction of the guide bar **3**, are uniformly distributed over a range corresponding to the total width b of the strip **1**, so that a uniform layer of pressure water forms over the entire width of the strip between the guide surface **10** and the surface of the strip **1**. As can be seen from FIG. 5, the nozzles **11** have their mouths or outlet openings **11***a* widened in fan-fashion in the longitudinal direction of the guide bars **3**, **3***a*, whereby the mouths **11***a* of adjacent nozzles merge with each other. As a result the jets of pressure water passing out of the nozzles **11** at a high speed spread in fan-fashion in the longitudinal direction of the guide bars **3** and **3***a* respectively, so that, even if adjacent nozzles **11** are spaced apart at relatively wide spaces c, the whole width b of the strip is sprayed with water jets emerging with a considerable amount of kinetic energy. The pressure water fed by the nozzles **11** forms between the curved guide surface **10** and the surface of the strip **1** facing this guide surface, a pressure water cushion by which the strip is lifted off the guide surface **10**. The water flows off laterally on both sides of the guide surface **10** in the direction w–w_1 and perpendicularly thereto.

In the embodiment illustrated in FIGS. 4 and 5, the guide bar **3** is exchangeably fixed on the carrier **4** by bolts **15**. Thus, the guide bar can be easily exchanged when strips of different materials, different thicknesses, different widths and with different scale formations are to be descaled.

In the construction illustrated in FIGS. 6 and 7, the guide bar **3** is composed of two complementary bending members of sections 3^1 and 3^2, being divided along a plane extending parallel to the longitudinal central plane *a*—*a*, which sections are clamped between jaws **23**, **24**. The clamping jaws **23**, **24** are drawn together by screws **25**. The facing contact surfaces of the guide bar sections 3^1 and 3^2 are ground and when in clamped position are pressed tightly one against the other by the jaws **23**, **24**. It is evident that it is also possible to provide packings between the contacting surfaces of the guide bars 3^1 and 3^2.

In the crest or apex of the curved guide surface **10** two elongated pressure water chambers **26**, **26***a* are arranged one behind the other in the longitudinal direction of the guide bar **3**. These pressure water chambers **26**, **26***a* are open toward the respective guide or bending surface **10**, reach to the full height of the guide bar **3** and together extend over about three-quarters of the strip width. The division plane of the guide bar **3** coincides with one of the longitudinal walls of the pressure water chambers **26**, **26***a*. On both sides of the pressure water chambers **26**, **26***a* the crown of the guide bar **3** is provided with a longitudinal groove **27** corresponding approximately to the width of the chambers, which groove is only shallow, being e.g. about 2 mms. in depth. With the aid of this shallow longitudinal groove a uniform pressure water cushion is formed at the crown of the guide bar **3** on each side of the pressure water chambers

26, 26*a* so that the scale will be washed away on both sides in the longitudinal direction of the guide bar.

The pressure water chambers **26**, **26***a* are each connected by two passages **28**, **28***a* provided in the clamping jaw **24** to a distributor passage **29** of relatively large cross section extending through the clamping jaw **24** in the longitudinal direction of the guide bar **3**. The distributor passage **29**, as in the embodiment illustrated in FIGS. 4 and 5, is connected at both ends to pressure water feed conduits **14**, **14***a*.

As shown particularly in FIG. 1, but also in FIGS. 2 and 3, each of the guide bars **3** and **3***a* is followed by a spraying device **16** and **16***a* respectively, provided with a plurality of nozzles distributed over the width *b* of the strip and by which the surface of the strip actually descaled is again sprayed with jets of water under high pressure. Such a spraying device **16** or **16***a* can obviously also be used when the guide bars are constructed as in the embodiments illustrated in FIGS. 6 and 7. The nozzles of the spraying device **16** or **16***a*, which are not shown in detail in FIGS. 1 to 3, are connected by a common distributor pipe and by a connection conduit **17** or **17***a* thereon, to a water feed conduit **18** or **18***a* leading to a high pressure pump, not shown in the drawings, like the connection conduits **14**, **14***a* of the nozzles **11** or the chambers **26**, **26***a*, or the distributor pipes **30**, **30***a*.

The strip **1**, after passing the spraying device **16** or **16***a*, is fed between at least one deflecting roller **5** or **8** and a brush **19** or **20** respectively. The brushes **19**, **20** engage the descaled surface of the strip sprayed by the preceding spraying device **16** or **16***a* and are adjustable in the direction t–t_1. Approximately tangential to the periphery of the brushes **19** and **20** respectively one or more adjustable nozzles **21**, **21***a* are arranged in the range between the strip and the periphery of the brushes, by which nozzles the contact area between the brushes and the surface of the strip is flushed by jets of water under pressure directed substantially tangentially to the periphery of the brushes. By these pressure water jets an improved brushing effect and a continuous cleaning of the rotating brushes **19**, **20** from particles of scale are attained. The spraying nozzles **21** and **21***a* respectively are, in the form of construction illustrated in FIGS. 1 to 3, connected to the same pressure water feeding conduits **18**, **18***a* as the connecting conduits **14**, **14***a* of the guide bars **3**, **3***a* or the connecting conduits **17**, **17***a* of the spraying devices **16**, **16***a*. As the pressure of the water fed through the nozzles **21**, **21***a* may be considerably lower than that of the water fed in the region of the guide bars **3**, **3***a* and through the spraying devices **16**, **16***a*, the nozzles **21**, **21***a* are connected to feed conduits **22**, **22***a* provided with throttle devices. Furthermore, independently adjustable throttle devices can also be arranged in the connection conduits **14**, **14***a* and **17**, **17***a* in order to enable the pressure and/or the quantity of water fed in the region of the guide bars **3**, **3***a* and through the spraying devices **16**, **16***a* to be regulated independently of each other. For the nozzles **21**, **21***a*, however, a separate water feed conduit under lower pressure can also be provided.

In the form of construction illustrated by way of example in FIG. 1, a brush is arranged beyond each spraying device **16**, **16***a*. In cases where exceptionally exigent requirements are placed on the surface condition of the strips, it is evident that two or more brushes **19** or **20** can be provided which are connected up in series. Furthermore, dry-operating brushes can also be provided instead of or in addition to the wet-operating brushes for polishing the strips. It is likewise possible to dry the descaled wet bands in a drying device, for example a continuous heating furnace, so as to avoid the formation of rust.

In order to improve the descaling effect, fine abrasives, such as corundum powder, steel turnings or the like, can be added to the water fed onto the surface of the strip in the region of the guide bars **3**, **3***a* and/or through the spraying devices **16**, **16***a*. In such cases, it is advisable to make the nozzles of the guide bars **3**, **3***a* as well as those of the distributor pipes **30**, **30***a* and the spraying devices **16**, **16***a* from wear-resistant and abrasion-proof material. In some cases, it will also be advisable to add to the water anti-corrosion agents so as to prevent the formation of rust during the descaling of strip iron.

The invention may be embodied in other specific forms without departing from the spirit or essential characteristics thereof. The present embodiments are therefore to be considered in all respects as illustrative and not restrictive, the scope of the invention being indicated by the appended claims rather than by the foregoing description and all changes which come within the meaning and range of equivalency of the claims are therefore intended to be embraced therein.

I claim:

1. In an apparatus for descaling strip material, in combination, means for guiding strip material along a selected path; and bending means located along said path for bending said strip material during passage along said path, said bending means including two curved and converging bending surface portions merging in an apex surface portion adapted to engage a surface of the strip material and said bending means including a plurality of nozzle means respectively communicating with said apex surface portion by means of outlet opening flaring in direction transverse to said path toward said apex surface portion for directing liquid under pressure between said surface of the strip material and said bending surface to build a layer of pressure liquid betwen said surfaces on which the strip material glides so as to reduce friction between said surfaces.

2. An arrangement as defined in claim **1** in which adjacent flaring outlet openings merge with each other.

3. In an apparatus for descaling strip material, in combination, means for guiding strip material along a selected path; bending means located along said path for bending said strip material during passage along said path, said bending means including a support, a pair of complementary bending members removably mounted on said support and having each a bending surface curved in direction of said path and meeting the bending surface of the other bending member in an apex surface portion adapted to engage a surface of the strip material; passage means formed in said support and in said bending members and opening into said apex surface portion for directing liquid under pressure between said surface of the strip material and said apex surface portion to build a layer of pressure liquid between said surfaces on which the strip material glides so as to reduce friction between said surfaces; and means for removably fastening said bending members to said support.

4. In an apparatus for descaling strip material, in combination, means for guiding strip material along a selected path; and bending means located along said path for bending said strip material during passage along said path, said bending means including two curved and converging bending surface portions each merging in an apex surface portion adapted to engage a surface of the strip material; a plurality of elongated pressure chambers formed in said bending means extending spaced from and aligned with each other transverse to said path substantially through a width equal to that of the strip material and being open toward the crest of said bending surface; and passage means including a distributor passage of relatively large cross section and extending transverse to said path through said bending means and a plurality of short passages spaced from each other along the length of said distributor passage and communicating with opposite ends thereof with the latter and said elongated pressure chambers, respectively, for directing liquid under sufficient contin-

uous pressure between said apex surface and the surface of said strip material to build and maintain a layer of liquid between said surfaces on which the strip material glides and thereby to prevent direct contact between said surfaces.

5. An arrangement as defined in claim 4 and including a plurality of channels open toward said bending surface and being aligned with said pressure chambers, said channels having a depth substantially smaller than that of said chambers and extending respectively between said chambers and adjacent ends of chambers and bending means.

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