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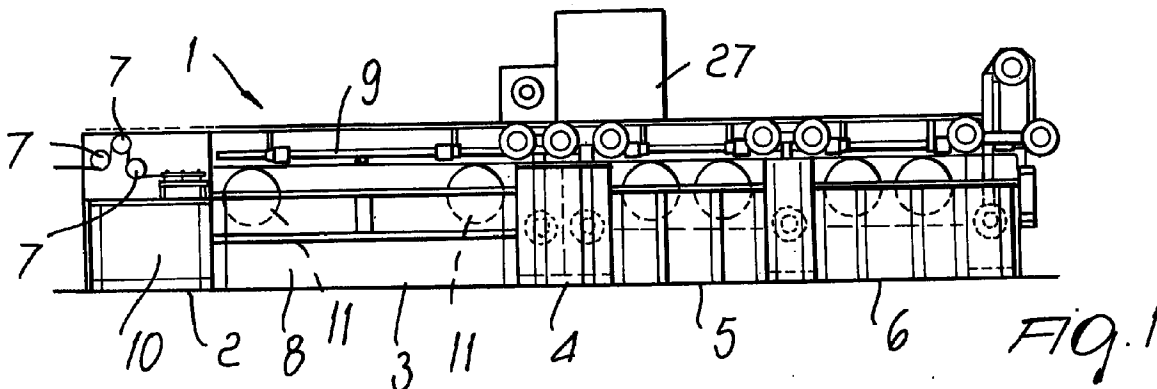
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(54) Apparatus for electrically treating ferrous and non ferrous metal wires

(57) An apparatus for the electrical treatment of ferrous and nonferrous metal wires, in line with a drawing apparatus, including: a station (2) for descaling and brushing a layer of oxides and calamine that is present on the metal wires that enter the apparatus; a station (3) for electrolytic pickling by adjustable retention in a bath of acid or basic solution; a washing station (4); and stations (5,6) for the further treatment of the wire that exits

from the washing station before being sent to a drawing apparatus. The apparatus further includes a crystallization device which is suitable to keep the concentration of the substances descaled from the metal wires below a preset value in order to extend the useful life of the pickling bath that is present in the pickling station.



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Description

[0001] The present invention relates to an apparatus for electrically treating ferrous and nonferrous metal wires in line with a drawing apparatus.

[0002] It is known that conventional carbon steel, owing to an effect that is inherent to its casting, rolling and cooling, has a layer of iron oxide and calamine on its surface. In particular, in steel coils with a diameter of 5.5 to 20 mm this layer, which consists of approximately 1.5% of the weight, does not allow adequate subsequent drawing. This problem is encountered in general in ferrous and nonferrous metal wires.

[0003] Three methods are currently known for continuously removing iron oxide and calamine layers.

[0004] A first method is mechanical descaling by twisting the metal; the second method is brushing, performed by mechanical removal with steel brushes; finally, a third method is grit blasting.

[0005] A chemical removal method is also known in which the entire metal is immersed in a bath having a suitable concentration.

[0006] Each one of these methods has an unsatisfactory cost/benefit ratio, because mechanical twisting alters the properties of the metal, brushing is not constant because it depends on the wear and pressure of the brushes, and grit blasting has to be performed with machines which are large and expensive to run. Chemical descaling or pickling offers the best final quality of the product, but since it is necessary to pickle the entire coil of metal wires in tanks with a capacity of 10,000 liters, without being able to remove and separate the surface scale, the bath is quickly contaminated and there is a consequent high cost for the disposal of the spent substances.

[0007] Therefore, pickling treatments using a chemical solution are very expensive and as such heavily affect the final cost of the drawn wire. Furthermore, the need to frequently change the chemical bath in which the metal to be treated is immersed entails problems linked to the disposal of the spent substances and therefore considerable pollution.

[0008] An aim of the present invention is therefore to provide an apparatus for electrically treating ferrous and nonferrous metal wires, in line with a drawing apparatus, which considerably reduces the rate of replacement of the chemical bath in which the metal wires to be treated are immersed.

[0009] An object of the present invention is to provide an apparatus for electrically treating ferrous and nonferrous metal wires, in line with a drawing apparatus, in which it is possible to recover, in a different form, the material produced by pickling.

[0010] A further object of the present invention is to provide an apparatus for electrically treating ferrous and nonferrous metal wires, in line with a drawing apparatus, provided with a means for suppressing toxic fumes produced by the chemical treatment to which the wire being

processed is subjected.

[0011] A further object of the present invention is to provide an apparatus for electrically treating ferrous and nonferrous metal wires, in line with a drawing apparatus, which is highly reliable, relatively easy to provide and at competitive costs.

[0012] This aim, these objects and others which will become apparent hereinafter are achieved by an apparatus for electrically treating ferrous and nonferrous metal wires, in line with a drawing apparatus, comprising: a station for descaling and brushing a layer of oxides and calamine that is present on the metal wires that enter the apparatus; at least one station for electrolytic pickling by adjustable retention in a bath of acid or basic solution; at least one washing station; and at least one station for the further treatment of the wire that exits from the washing station before being sent to a drawing apparatus; characterized in that it furthermore comprises at least one crystallization device which is suitable to keep the concentration of the substances descaled from the metal wires below a preset value in order to extend the useful life of the pickling bath that is present in the pickling station.

[0013] Further characteristics and advantages of the invention will become apparent from the description of a preferred but not exclusive embodiment of the apparatus according to the invention, illustrated only by way of non-limitative example in the accompanying drawings, wherein:

Fig. 1 is a lateral elevation view of the apparatus according to the present invention;

Fig. 2 is a plan view of the apparatus shown in Fig. 1;

Fig. 3 is a plan view of the crystallization device used in the apparatus according to the present invention;

Fig. 4 is a plan view of the fume suppression device used in the apparatus according to the present invention;

Fig. 5 is a plan view of a concentrator/evaporator device used in the apparatus according to the present invention.

[0014] With reference to the above figures, the apparatus according to the invention, generally designated by the reference numeral 1, includes, preferably in sequence: a first descaling and brushing station 2; a station 3 for pickling by immersion in a chemical bath; a washing station 4; a phosphatizing and copper-plating station 5; and a borax coating station 6. The metal wire introduced in the descaling and brushing station 2 finally exits from the borax coating station 6 to be introduced in a wiredrawing machine, not shown in the fig-

ures.

[0015] The descaling and brushing station has a series of mutually opposite rollers 7 which descale and brush the wire that enters the apparatus, with a blower which collects the removed material.

[0016] The descaling and brushing station includes at least two pairs of rollers 7, of which at least two have an abrasive surface and have a brushing action, arranged along two axes. The forced-air blower removes the finer residues produced by descaling and brushing and conveys them to a specifically provided container 10.

[0017] The subsequent pickling station includes a treatment tank 8, having a self-supporting structure made of acid-resistant material, and sets of rollers for guiding and advancing the wire 11 which are actuated by the pneumatic cylinders. The pickling station 3 also includes a device 9 for cathode/anode contact or bipolar effect without contact or with alternating contact for the electrical treatment of the wires that enter the apparatus according to the invention.

[0018] The electrolytic pickling that occurs in the tank 8, which contains an acid solution which becomes rich in iron sulfate after pickling, is performed while keeping the concentration of the solution constantly below approximately 70-80 g/l in order to prevent inhibition of the efficiency of the solution. This effect is achieved by means of a crystallization device, designated by the reference numeral 20, which separates the solidified solute from the solvent liquid that dissolves it (that is to say, the acid or basic solution contained in the pickling tank 8). After the pickling treatment, the metal wires are sent to the washing station 4 that follows.

[0019] The crystallization device includes a collecting pump 21 which collects the contaminated acid solution and feeds it into a secondary collection tank 22 by which the contaminated solution is cooled, by virtue of a heat exchanger 23, down to approximately 3-4 °C to form ferrous sulfates in the form of crystals. At this point, the crystals are fed into a settling/separator unit 24, in which a scraper blade 25 separates the liquid part from the crystals; the liquid part is pure acid, which is to be fed back into the acid bath in the pickling tank 8.

[0020] Further liquid residue is retrieved from the dripping of the crystals, and the dry crystals are finally usable for various purposes, for example in agriculture to modify the acidity or basicity of soils.

[0021] The crystals separated out of the solution are collected in a suitable filtering bag made of polypropylene for additional filtration or separation of the acid from the crystals, in order to obtain dry crystals as described above.

[0022] At the washing station 4 and at the phosphatizing and copper-plating station 5 there is a device 27 for suppressing and neutralizing the vapors of the treatment liquids by virtue of a fan 28 which produces negative pressure in the apparatus according to the invention, and nozzles which feed water for suppression from the upper region of the columns, designated by the

reference numeral 29, by means of a pump 30'.

[0023] At the washing stations there is a device 30 for concentrating the wash water by evaporation, which concentrates the pollutants (sulfates and iron) and returns them to the previous crystallization process and produces demineralized water to be reused for the washes in a closed circuit.

[0024] The device consists of a cylindrical tank 31 made of acid-resistant material and placed in vacuum by a pump 32. The wash water to be evaporated is fed into the tank 31, and inside there is a coil in which compressed gas flows, causing the wash water to boil.

[0025] Distilled water forms in the upper part of the device 30 and the concentrate to be evacuated in the crystallization device 20 forms in the lower part.

[0026] At the outlet of the first washing station 4, the wire is brushed with at least two brushes made of plastic whose rotation rate is adjustable.

[0027] After the pickling step, the effectiveness of the washes applied to the wire is increased by a pressure pump which sprays water with great force onto the wire.

[0028] The phosphatizing station 5 and the borax descaling station 6 have indirect-diffusion heat exchangers which are immersed in diathermic oil for heating above 70°C.

[0029] In Fig. 2, the reference numeral 35 designates a forced air source which dries the wire that exits from the borax descaling station or in any case exits from the last processing station through which the wire is passed.

[0030] The borax coating and phosphatizing stations can in fact be present in combination, or there may be a copper-plating and borax coating station, or there may be a zinc-plating and borax coating station or there may be just a single borax coating station.

[0031] In practice it has been observed that the apparatus according to the invention fully achieves the intended aim, since it allows to recycle the chemical pickling solution when it becomes contaminated owing to the residues left by the metal wires that are immersed in it.

[0032] The crystallization device allows to "clean" the acid solution and recover the iron sulfates eliminated by the metal wires to convert them to a crystal form.

[0033] Furthermore, the device for suppressing the vapors of the treatment liquids to which the metal wire allows to reduce the pollution produced by the apparatus according to the invention.

[0034] The vapor suppression device is combined with the device for concentrating the wash water by evaporation, allowing to reduce the overall pollution of the apparatus.

[0035] The apparatus thus conceived is susceptible of numerous modifications and variations, all of which are within the scope of the inventive concept.

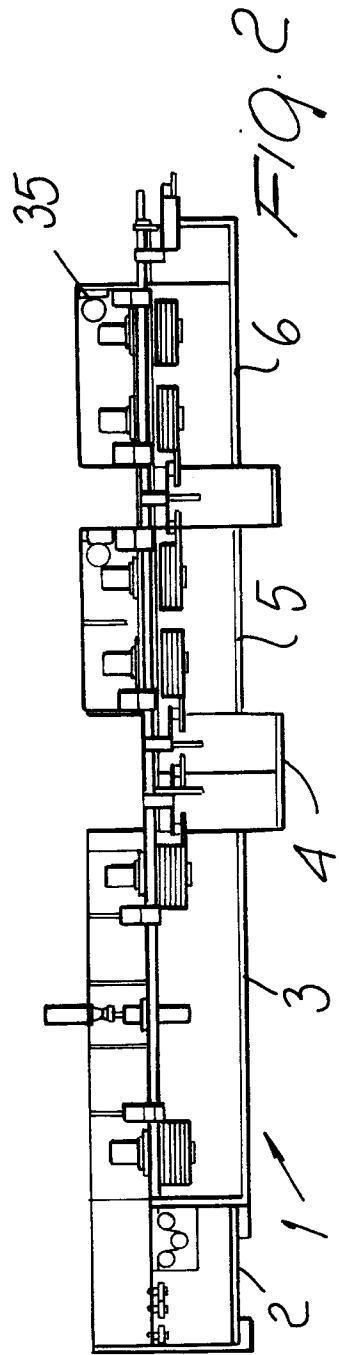
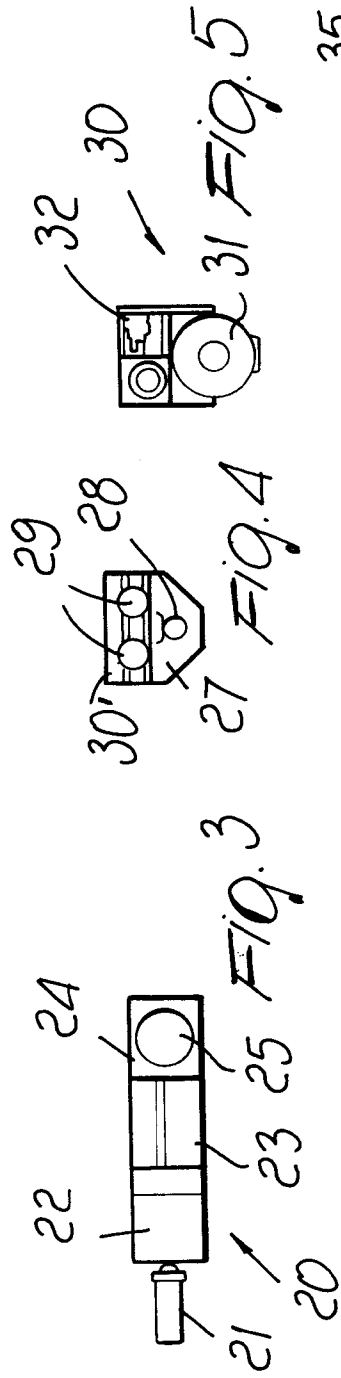
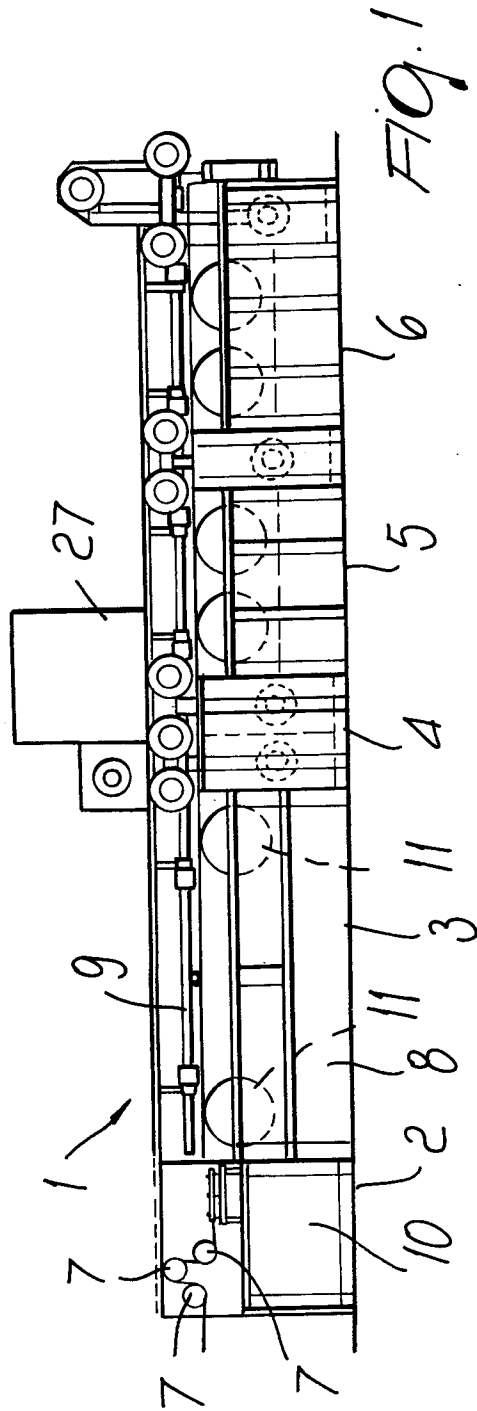
[0036] Thus, for example, the rollers for the advancement of the wire 7 and in general all the rollers that are present in the apparatus according to the invention can

be arranged so that instead of having a rotation axis which is parallel to the resting surface of the apparatus they have a rotation axis which is perpendicular to the resting surface, so as to reduce the bulk of the apparatus.

[0037] Finally, all the details may be replaced with other technically equivalent elements. In practice, the materials and the dimensions may be any according to the requirements and the state of the art.

Claims

1. Apparatus for the electrical treatment of ferrous and nonferrous metal wires, in line with a drawing apparatus, comprising in sequence: a station (2) for descaling and brushing a layer of oxides and calamine that is present on the metal wires that enter the apparatus; at least one station (3) for electrolytic pickling by adjustable retention in a bath of acid or basic solution; at least one washing station (4); and at least one station (5,6) for the further treatment of the wire that exits from said washing station before being sent to a drawing apparatus; characterized in that it furthermore comprises at least one crystallization device (20) which is suitable to keep the concentration of the substances descaled from the metal wires below a preset value in order to extend the useful life of the pickling bath that is present in said pickling station.
2. Apparatus according to claim 1, characterized in that said crystallization device (20) comprises a collecting pump (21) which is suitable to feed the solution contained in said pickling bath to a secondary collecting tank (22) and then to a heat exchanger (23) to reduce the temperature of said solution.
3. Apparatus according to claim 2, characterized in that said crystallization device furthermore comprises a settling/separator unit (24) in which the solution cooled by said heat exchanger is introduced.
4. Apparatus according to claim 3, characterized in that said crystallization device furthermore comprises a rotating scraper blade (25) which is suitable to separate ferrous sulfate crystals with acid from the pickling liquid.
5. Apparatus according to one or more of the preceding claims, characterized in that said settling/separator unit (24) is connected to a polypropylene filtering bag for an additional filtration and separation of crystals obtained in said settling/separator unit.
6. Apparatus according to one or more of the preceding claims, characterized in that it furthermore comprises at least one device (30) for concentrating wash water by evaporation, which is arranged at said at least one washing station (4) and comprises a tank (31) which is in vacuum and contains a heating coil in order to produce the boiling of the wash water fed into said tank.
7. Apparatus according to one or more of the preceding claims, characterized in that it furthermore comprises at least one device (27) for suppressing and neutralizing fumes of the liquids for treating said metal wires.
8. Apparatus according to one or more of the preceding claims, characterized in that said device (27) for suppressing and neutralizing the fumes comprises a fan (28) and nozzles (29) for introducing suppression water.
9. Apparatus according to one or more of the preceding claims, characterized in that said additional treatment stations (5,6) located after said at least one washing station comprise indirect-diffusion heat exchangers which are immersed in diathermic oil to increase the temperature inside said stations.
10. Apparatus according to one or more of the preceding claims, characterized in that the metal wires fed into said apparatus are conveyed through said stations by means of advancement rollers.
11. Apparatus according to claim 10, characterized in that the rotation axis of said rollers is substantially perpendicular to the resting plane of said apparatus.
12. Apparatus according to one or more of the preceding claims, characterized in that the pickling bath, purified by said crystallization device, is fed back into the pickling tank.





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EUROPEAN SEARCH REPORT

Application Number
EP 97 83 0747

DOCUMENTS CONSIDERED TO BE RELEVANT		
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim
A	DE 195 21 132 C (POLIGRAT HOLDING GMBH) 17 October 1996 ---	
A	US 3 900 955 A (PETERSON JOSEPH C) 26 August 1975 ---	
A	US 4 276 133 A (NAGANO HIROO ET AL) 30 June 1981 ---	
A	US 4 201 650 A (FUKUDA TAKASHI ET AL) 6 May 1980 -----	
The present search report has been drawn up for all claims		
CLASSIFICATION OF THE APPLICATION (Int.Cl.6) C25F7/02		
TECHNICAL FIELDS SEARCHED (Int.Cl.6) C25F B21C C23G		
Place of search	Date of completion of the search	Examiner
THE HAGUE	9 June 1998	Van Leeuwen, R
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document

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