(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 0 914 217 B1

(12) **EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention of the grant of the patent:
22.10.2003 Bulletin 2003/43

(21) Application number: **98913270.9**

(22) Date of filing: **26.03.1998**

(51) Int Cl.[7]: **B08B 1/02**, C23G 5/00

(86) International application number:
PCT/US98/06206

(87) International publication number:
WO 98/042456 (01.10.1998 Gazette 1998/39)

(54) **APPARATUS AND METHOD FOR REDUCING CONSUMPTION OF ALCOHOL USED IN CLEANING OXIDIZED HOT METAL SURFACES**

GERÄT UND VERFAHREN ZUR EINSCHRÄNKUNG DES ALKOHOLVERBRAUCHS BEIM REINIGEN VON OXIDIERTEN HEISSEN METALLOBERFLÄCHEN

APPAREIL ET PROCEDE DE REDUCTION DE L'ALCOOL UTILISE DANS LE DECAPAGE DE SURFACES METALLIQUES CHAUDES OXYDEES

(84) Designated Contracting States:
DE FR GB IT SE

(30) Priority: **27.03.1997 US 826245**

(43) Date of publication of application:
12.05.1999 Bulletin 1999/19

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Description

Field of the Invention

[0001] The present invention generally relates to an apparatus and method for reducing consumption of alcohol used in cleaning oxidized hot metal surfaces. For example, the invention can be employed in an apparatus for continuous cleaning or pickling of cast and rolled copper rod.

Description of the Prior Art

[0002] Hot-rolled copper or copper alloy rod used in the manufacture of wire is usually formed into coils for convenient handling. The rod accumulates a surface scale or oxide when exposed to the atmosphere, and this scale should be completely removed before the rod is used in the manufacture of wire.

[0003] In the prior art, the surface scale or oxide has been typically removed from the surface of copper base products by the common practice of "pickling" the products, that is, contacting their surfaces with a "pickling" liquid such as a solution including sulfuric acid, nitric acid, or other acids. Such methods and apparatus are disclosed in the following U.S. patents, which are assigned to the assignee of the present invention: 3,623,532; 4,005,744; and 4,181,091.

[0004] In more recent times, alternatives to "pickling" using acid solutions have been developed. Such alternative solutions are necessitated by the operating costs associated with the requirement to use acid-resistant materials, to avoid ecological problems associated with waste acid disposal, and to produce a more consistent and better quality product. One such alternative has involved the use of organic reducing agents, such as alcohol, aldehydes, ketones and organic acids. However, the use of such agents must be carefully controlled to avoid adverse effects on the environment.

[0005] Therefore, more modern methods and apparatus have involved the collection of the cleaning mixture (or reducing agent mixture) vapors and the conveyance of the collected vapors to a central point for concentration and condensation. Such a method and apparatus are disclosed in U.S. Patent No. 4,899,798, which is assigned to the assignee of the present invention.

[0006] Thus, alcohol is often used to chemically reduce the oxidized surface of continuously cast and rolled hot copper and copper alloy metal products. Such alcohol is in an aqueous solution typically of about 3% alcohol. After the reduction process, small quantities of the alcohol solution remain on the surface of the moving rod, and are usually removed with on or more blasts of air provided by an "airwipe" apparatus. In such methods and apparatus of the prior art, alcohol droplets removed from the rod as a result of the airwipe drain into a solution recovery tank for further disposition and/or recycling and reuse.

[0007] However, in the prior art apparatus, a portion of the air utilized in the airwipe device passes out through the drain of the airwipe enclosure into the recovery tank, and sweeps across the surface of the alcohol liquid in the tank thereby removing volatile alcohol from the tank. Since this alcohol-laden air must be treated before disposal to the external atmosphere, e.g., by thermal destruction or condensation of the alcohol, there results a substantial loss of alcohol. Prior to the present invention, about 50% of the alcohol used in the cleaning process was lost due to this phenomenon. Thus, there is a significant need for a method and apparatus which solves this disadvantageous situation in the prior art apparatus and method.

Summary of the Invention

[0008] The present invention generally relates to an apparatus and method for reducing the consumption of alcohol used in cleaning oxidized hot metal surfaces. More particularly, the invention accomplishes that function in a method and apparatus for continuously quench-pickling cast and rolled copper and copper alloy rod in a continuous casting and rolling process. Essentially, the invention accomplishes the desired objective by providing a liquid trap in the drain line between the airwipe enclosure or box and the storage or recovery tank. This liquid trap separates the airwipe air from the liquid alcohol solution according to the typical function of a water trap.

[0009] For the apparatus disclosed, the amount of alcohol solution contacted by the airwipe air is only that small amount of alcohol solution which is carried over from the pickling or cleaning tube into the airwipe, and the small surface of the liquid trap. To meet environmental requirements, the airwipe air discharged via the normal vent tubes from the airwipe box may still require treatment by condensation of the alcohol or thermal destruction of the alcohol. However, the quantity of alcohol carried by this air is insignificant compared to the total amount of alcohol being used and the amount of volatile alcohol carried out of the recovery tank by the air discharged into the tank in the prior art apparatus.

[0010] Therefore, it is a primary object of the present invention to provide an apparatus and method for reducing the consumption of alcohol used in pickling or cleaning oxidized hot metal surfaces.

[0011] It is an additional object of the present invention to provide an apparatus and method wherein a liquid trap is provided in the drain line between the airwipe box and the storage or recovery tank to separate air from the alcohol solution.

[0012] The above and other objects, and the nature of the invention, will be more clearly understood by reference to the following detailed description, the associated drawings, and the appended claims.

Brief Description of Drawings

[0013]

Figure 1 is a diagrammatic representation of an apparatus for the pickling or cleaning of continuously cast and rolled rod in accordance with the present invention.

Figure 2 is a side elevation view in cross-section of the airwipe box employed in the apparatus of Figure 1.

Figure 3 is an end elevation view partly in cross-section taken along line III-III of Figure 2 of the airwipe box employing a liquid trap in accordance with the present invention.

Detailed Description of the Invention

[0014] The invention will now be described in more detail with reference to the various figures of the drawings.

[0015] Figure 1 is a diagrammatic representation of an apparatus for the pickling or cleaning of continuously cast and rolled rod in accordance with the present invention. As seen therein, the apparatus 10 comprises a cleaning pipe or tube 12 and various spray boxes 14a-14h positioned at predetermined intervals along the length of the pipe 12, as well as a drain box 16 positioned at an intermediate point along the pipe 12. The apparatus 10 also includes an airwipe assembly 17 with a plurality of airwipe boxes 18 disposed at the downstream end of the pipe 12, as well as pinch rolls 22 through which the rod passes prior to being delivered to a conventional rod coiler (not shown). Finally, the apparatus 10 includes a storage or recovery tank 20 connected to the airwipe boxes 18 of the airwipe assembly 17 via one or more drains employing a liquid trap 19.

[0016] In operation, the rod being processed passes through the pipe 12, and successively past spray boxes 14a-14h. Spray boxes 14a-14h spray the rod with a cleaning solution (e.g., a 3% aqueous alcohol solution), and the drain box 16 is provided at an intermediate point of the pipe 12 for draining off excess solution.

[0017] Once the rod passes through each of the spray boxes 14a-14h, it enters the first airwipe box 18 where it is subjected to a blast of air at a pressure of from about 1 atm. to about 10 atm. for the purpose of removing solution droplets from the surface of the rod. These droplets are drained off via liquid trap 19 to storage or recovery tank 20. The resulting rod, with the alcohol droplets removed, passes between pinch rolls 22 and is conveyed to a rod coiler (not shown) where it is formed into coils for further disposition or transport.

[0018] In the airwipe boxes 18, air preferably enters the pipe 12 in such a manner as to flow in a direction opposite, i.e., countercurrent, to the direction of travel of the metal rod. Moreover, the blast of air introduced into pipe 12 passes through a relatively small gap between the airwipe housing and the outer surface of the metal rod, effectively removing droplets of cleaning solution from the surface of the metal rod in the process. The droplets of cleaning solution fall to the bottom of the airwipe boxes 18 and are drained through trap 19 into storage or recovery tank 20.

[0019] Figure 2 illustrates one airwipe box 18 employed in the apparatus of Figure 1, and Figure 3 is an end view of that box taken along line III-III of Figure 2 showing the liquid trap 19 in accordance with the present invention. As seen therein, airwipe box 18 includes air vent pipes 30 and 32, a threaded rod guide 34 mounted on the upstream side of box 18 with a slotted nut 34a, a conventional airwipe 36, liquid drain pipes 38 and 40, rod exit opening 42, and an air inlet 44 connected to the airwipe 36.

[0020] In operation, the metal rod (not shown) enters airwipe box 18 via guide 34 and passes from left to right in Figure 2, emerging from box 18 via exit opening 42. An air blast is injected into airwipe 36 via air inlet 44. Preferably, the air blast is directed circumferentially about the rod and flows in a direction from right to left in Figure 2, that is, in a direction opposite to the direction of travel of the metal rod.

[0021] As a result of being subjected to the blast of air, droplets of cleaning solution adhering to the outer surface of the metal rod are removed, fall downwardly to the bottom of the airwipe box 18, and are drained off via drain pipes 38 and 40. As mentioned previously, a particular problem with the prior art apparatus is that some of the air injected through inlet 44 passes through pipes 38 and 40. As a result, such air flows across the large surface area of liquid solution collected in the storage/recovery tank 20 (Figure 1), and this results in the removal and loss of large quantities of volatile alcohol collected in the space over the solution in the tank 20.

[0022] The inventive arrangement disclosed herein provides a solution to this problem. Specifically, in accordance with the invention, a liquid trap 19 is connected to drain pipes 38 and 40. As seen in Figure 3, the liquid trap 19 is preferably in the shape of oppositely connected U-shaped tubes according to a common design of water traps. As a result of the configuration of the liquid trap 19, air cannot escape through pipe 40 due to the fact that liquid solution collected in the trap fills the trap 19 to some level indicated by the dashed lines 56 in Figure 3. Thus, liquid collected in the trap 19 prevents the air in box 18 from exhausting through drain pipes 38 and 40, flowing into tank 20, and disadvantageously removing volatile alcohol from tank 20. As a result, the present invention achieves substantial savings in the overall cleaning process because of the retention of most of the collected cleaning solution.

[0023] It has been found that, as a result of implementation of the present invention, loss of cleaning solution (such as alcohol) is substantially eliminated whereas, in arrangements of the prior art, approximately 50% of the cleaning solution was lost as a result of air passing out

of box 18 into and through storage/recovery tank 20. The inventive arrangement also has advantages from the environmental standpoint in that, when alcohol is used as a cleaning solution, the essential elimination of evaporation of alcohol results in drastic cutback in the emission or exhaustion of alcohol into the external atmosphere.

[0024] Although certain presently preferred embodiments of the present invention have been specifically described herein, it will be apparent to those skilled in the art to which the invention pertains that variations and modifications of the various embodiments shown and described herein may be made without departing from the scope of the invention. Accordingly, it is intended that the invention be limited only to the extent required by the appended claims and the applicable rules of law.

Claims

1. Apparatus (10) for reducing consumption of volatile components of a solution used in cleaning an oxidized metal surface, comprising:

airwipe means (17, 18; 36) for applying a blast of air to the metal surface so as to remove droplets of said solution used in cleaning the oxidized metal surface;
drain means (16; 38, 40) for carrying the removed droplets away from the metal surface;
recovery means (20) connected to said drain means (16; 38, 40) for receiving the removed droplets carried away from the metal surface;

characterized by providing trap means (19) disposed in said drain means (16; 38, 40) for preventing the exhaustion of air from said airwipe means (17, 18; 36) into said recovery means (20).

2. The apparatus (10) of claim 1, wherein said trap means comprises a liquid trap (19) including a first portion connected to said drain means (38, 40) and extending in a downward direction, a second portion connected to an end of said first portion remote from said drain means and extending in an upward direction, and a third portion connected to an end of said second portion remote from said first portion and extending in the downward direction.

3. The apparatus (10) of claim 1, including a plurality (17) of said airwipe means (18; 36) each airwipe means (18; 36) having trap means (19) in the drain means (19; 38, 40) connected to the recovery means (20).

4. The apparatus (10) of claim 1, wherein said cleaning solution is aqueous alcohol.

5. The apparatus (10) of claim 1, wherein said metal surface is a copper rod surface.

6. The apparatus (10) of claim 1, wherein said blast of air comprises air at a pressure of from about 1 bar (≈ 1 atm) to about 10 bar (≈ 10 atm).

7. A method for reducing consumption of volatile components of a solution used in cleaning an oxidized metal surface comprising the steps of:

applying a blast of air to the metal surface with an airwipe (36) so as to remove droplets of the solution used in cleaning the oxidized metal surface;
collecting the removed droplets in an enclosure (18) surrounding the airwipe (36);
draining the collected droplets from the enclosure (18) through a drain (38, 40; 19) and into a storage tank (20);

characterized by providing trap means (19) between said enclosure (18) and said storage tank (20) for preventing exhaustion of air from said enclosure (18) into said storage tank (20).

8. The method of claim 7, wherein said preventing step comprises providing a liquid trap (19) in the drain (19; 38, 40) between the enclosure (18) and the storage tank (20).

9. The method of claim 8, wherein said preventing step further comprises collecting the removed droplets in the liquid trap (19) so as to block the exhaustion of air into the storage tank (20).

10. The method of claim 7, wherein said blast of air comprises air at a pressure of from about 1 bar (≈ 1 arm) to about 10 bar (≈ 10 atm).

11. Apparatus (10) for cleaning an oxidized metal surface of a continuously cast and rolled metal rod comprising a cleaning pipe (12) through which said rod travels, means (14) for introducing a cleaning solution having volatile components into the pipe (12) in contact with the metal surface of the rod, airwipe means (17) downstream of the pipe (12) for wiping the solution from the rod surface with a blast of air, means (18) for collecting the solution wiped from the rod surface, tank means (20) for storing the collected solution, and drain means (38, 40; 19) for draining the solution from the collecting means (18) into the tank means (20),

characterized by trap means (19) disposed in the drain means for preventing air from the airwipe means (17, 18; 36) from flowing into the tank means (20) and carrying off the volatile components from the cleaning solution in the tank means (20).

12. The apparatus (10) of claim 11, wherein said blast of air comprises air at a pressure of from about 1 bar (≈ 1 atm) to about 10 bar (≈ 10 atm).

13. The apparatus (10) of claim 11, wherein said metal rod is a copper rod.

14. The apparatus (10) of claim 11, wherein said cleaning solution is aqueous alcohol.

Patentansprüche

1. Vorrichtung (10) zur Verminderung des Verbrauchs flüchtiger Bestandteile einer zur Reinigung einer oxidierten Metalloberfläche verwendeten Lösung, die umfasst:

Luftwischeinrichtungen (17, 18; 36) zum Beaufschlagen der Metalloberfläche mittels eines Luftstroms zum Entfernen von Tröpfchen der zur Reinigung der oxidierten Metalloberfläche verwendeten Lösung;
Ablaufeinrichtungen (16; 38, 40) zur Abführung der von der Metalloberfläche entfernten Tröpfchen;
Rückgewinnungseinrichtungen (20), die mit den Ablaufeinrichtungen (16; 38, 40) zur Aufnahme der von der Metalloberfläche abgeführten entfernten Tröpfchen verbunden sind;

gekennzeichnet durch Abscheideinrichtungen (19), die in den Ablaufeinrichtungen (16; 38, 40) vorgesehen sind, um das Abströmen von Luft aus den Luftwischeinrichtungen (17, 18; 36) in die Rückgewinnungseinrichtungen (20) zu verhindern.

2. Vorrichtung (10) nach Anspruch 1, bei der die Abscheideinrichtungen einen Flüssigkeitsabscheider (19) umfassen, der einen ersten, mit den Ablaufeinrichtungen (38, 40) verbundenen und sich in Abwärtsrichtung erstreckenden Teil, einen zweiten, mit einem Ende des ersten Teils entfernt vom Ablaufmittel verbundenen und sich in Aufwärtsrichtung erstreckenden Teil sowie und einen dritten Teil besitzt, der entfernt vom ersten Teil mit einem Ende des zweiten Teils verbunden ist und sich in Abwärtsrichtung erstreckt.

3. Vorrichtung (10) nach Anspruch 1 mit einer Mehrzahl (17) Luftwischeinrichtungen (18; 36), wobei jede Luftwischeinrichtung (18; 36) Abscheidmittel (19) in den mit den Rückgewinnungseinrichtungen (20) verbundenen Ablaufeinrichtungen (19; 38, 40) besitzt.

4. Vorrichtung (10) nach Anspruch 1, wobei die Reinigungslösung wässriger Alkohol ist.

5. Vorrichtung (10) nach Anspruch 1, wobei die Metalloberfläche die Oberfläche von Kupfer-Stabmaterial ist.

6. Vorrichtung (10) nach Anspruch 1, bei welcher der Luftstrom Luft mit einem Druck von etwa 1 bar (≈ 1 atm) bis etwa 10 bar (≈ 10 atm) enthält.

7. Verfahren zur Verminderung des Verbrauchs von flüchtigen Bestandteilen einer zum Reinigen oxidierter Metalloberflächen verwendeten Lösung mit folgenden Schritten:

Beaufschlagen der Metalloberfläche mittels eines Luftwischers (36) mit einem Luftstrom, um Tröpfchen der zum Reinigen der oxidierten Metalloberfläche verwendeten Lösung zu entfernen;
Sammeln der entfernten Tröpfchen in einer Kammer (18), die den Luftwischer (36) umgibt;
Abführen der gesammelten Tröpfchen aus der Kammer (18) durch einen Abfluss (38, 40; 19) in einen Lagerbehälter (20);

gekennzeichnet durch Abscheideinrichtungen (19) zwischen der Kammer (18) und dem Lagerbehälter (20), um das Abströmen von Luft aus der Kammer (18) in den Lagerbehälter (20) zu verhindern.

8. Verfahren nach Anspruch 7, bei dem die Verhinderungsmassnahme die Verwendung eines Flüssigkeitsabscheiders (19) im Abfluss (19; 38, 40) zwischen der Kammer (18) und dem Lagerbehälter (20) umfasst.

9. Verfahren nach Anspruch 8, bei dem die Verhinderungsmassnahme ausserdem das Sammeln der entfernten Tröpfchen im Flüssigkeitsabscheider (19) umfasst, um das Abströmen von Luft in den Lagerbehälter (20) zu sperren.

10. Verfahren nach Anspruch 7, bei dem der Luftstrom Luft mit einem Druck von etwa 1 bar (≈ 1 atm) bis etwa 10 bar (≈ 10 atm) umfasst.

11. Vorrichtung (10) zum Reinigen einer oxidierten Metalloberfläche eines kontinuierlich gegossenen und gewalzten Metallstabes, welche umfasst:

ein Reinigungsrohr (12), durch das der Stab wandert, Einrichtungen (14) zum Einleiten einer Reinigungslösung mit flüchtigen Bestandteilen in das Rohr (12) zum Kontakt mit der Metalloberfläche des Stabes, Luftwischeinrichtungen (17) abstromseitig vom Rohr (12) zum Abwischen der Lösung von der Staboberfläche mit einem Luftstrom, Einrichtungen (18) zum

Sammeln der von der Staboberfläche abgewischten Lösung, Behältereinrichtungen (20) zur Lagerung der gesammelten Lösung, und Ablaufeinrichtungen (38, 40; 19) zum Ablassen der Lösung aus der Sammeleinrichtung (18) in die Behältereinrichtungen (20),

gekennzeichnet durch Abscheideinrichtungen (19) in den Ablaufeinrichtungen zur Vermeidung des Abströmens von Luft aus den Luftwischeinrichtungen (17, 18; 36) in die Behältereinrichtungen (20) und des Mitreissens der flüchtigen Bestandteile aus der Lösung in den Behältereinrichtungen (20).

12. Vorrichtung (10) nach Anspruch 11, bei welcher der Luftstrom Luft mit einem Druck von etwa 1 bar (≈ 1 atm) bis etwa 10 bar (≈ 10 atm) umfasst.

13. Vorrichtung (10) nach Anspruch 11, bei welcher der Metallstab ein solcher aus Kupfer ist.

14. Vorrichtung (10) nach Anspruch 11, bei der die Reinigungslösung wässriger Alkohol ist.

Revendications

1. Appareil (10) pour réduire la consommation de composants volatiles d'une solution utilisée dans le nettoyage d'une surface métallique oxydée, comprenant:

un moyen d'essuyage à l'air (17, 18; 36) pour appliquer un souffle d'air à la surface métallique de manière à enlever les gouttelettes de ladite solution utilisée dans le nettoyage de la surface métallique oxydée;
un moyen de drainage (16; 38, 40) pour transporter les gouttelettes enlevées loin de la surface métallique;
un moyen de récupération (20) relié audit moyen de drainage (16; 38, 40) pour recevoir les gouttelettes enlevées qui ont été transportées loin de la surface métallique;

caractérisé par la réalisation d'un moyen de capture (19) disposé dans ledit moyen de drainage (16; 38, 40) pour empêcher l'échappement d'air à partir dudit moyen d'essuyage à air (17, 18; 36) vers ledit moyen de récupération (20).

2. L'appareil (10) de la revendication 1, dans lequel ledit moyen de capture comprend un piège à liquide (19) incluant une première portion reliée au dit moyen de drainage (38, 40) et s'étendant dans une direction vers le bas, une seconde portion reliée à une extrémité de ladite première portion éloignée dudit moyen de drainage et s'étendant dans une direction vers le haut, et une troisième portion reliée à une extrémité de ladite seconde portion éloignée de ladite première portion et s'étendant dans la direction vers le bas.

3. L'appareil (10) de la revendication 1, incluant une pluralité (17) desdits moyens d'essuyage à l'air (18; 36), chaque moyen d'essuyage à l'air (18; 36) possédant un moyen de capture (19) dans le moyen de drainage (19; 38, 40) relié au moyen de récupération (20).

4. L'appareil (10) de la revendication 1, dans lequel ladite solution de nettoyage est de l'alcool aqueux.

5. L'appareil (10) de la revendication 1, dans lequel ladite surface métallique est une surface de barre en cuivre.

6. L'appareil (10) de la revendication 1, dans lequel ledit souffle d'air comprend de l'air à une pression allant d'environ 1 bar (≈ 1 atmosphère) à environ 10 bars (≈ 10 atmosphères).

7. Un procédé pour réduire la consommation de composants volatiles d'une solution utilisée dans le nettoyage d'une surface métallique oxydée comprenant les étapes consistant à:

appliquer un souffle d'air à la surface métallique avec un essuyeur à l'air (36) de manière à enlever les gouttelettes de la solution utilisée dans le nettoyage de la surface métallique oxydée;
collecter les gouttelettes enlevées dans une enceinte (18) entourant l'essuyeur à air (36);
drainer les gouttelettes collectées à partir de l'enceinte (18) à travers un drain (38, 40; 19) et vers un réservoir de stockage (20);

caractérisé par la réalisation d'un moyen de capture (19) entre ladite enceinte (18) et ledit réservoir de stockage (20) pour empêcher l'échappement d'air à partir de ladite enceinte (18) vers ledit réservoir de stockage (20).

8. Le procédé de la revendication 7, dans laquelle ladite étape d'empêchement comprend la réalisation d'un piège à liquide (19) dans le drain (19; 38, 40) entre l'enceinte (18) et le réservoir de stockage (20).

9. La méthode de la revendication 8, dans laquelle ladite étape d'empêchement comprend en outre la collecte des gouttelettes enlevées dans le piège à liquide (19) de manière à bloquer l'échappement d'air vers le réservoir de stockage (20).

10. Le procédé de la revendication 7, dans lequel ledit souffle d'air comprend de l'air à une pression allant d'environ 1 bar (≈1 atmosphère) à environ 10 bars (≈ 10 atmosphères).

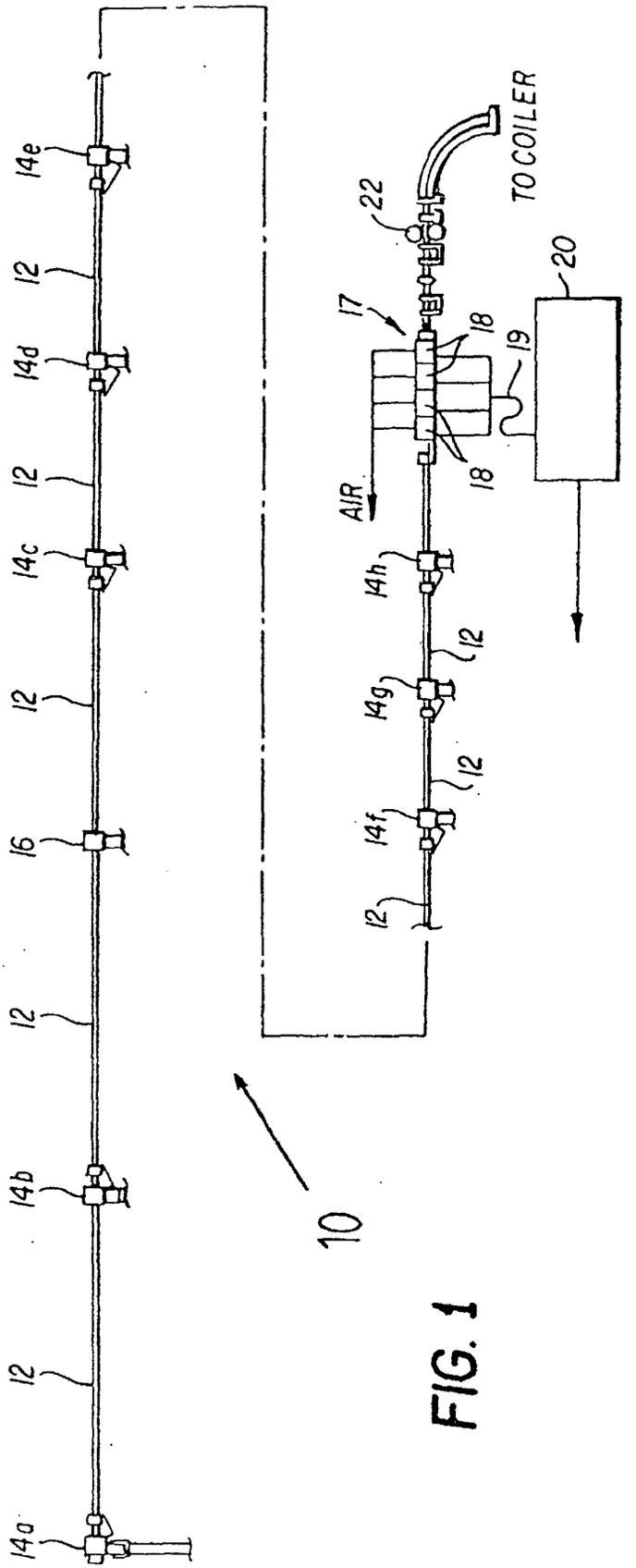
11. Appareil (10) pour nettoyer une surface métallique oxydée d'une barre métallique coulée de manière continue et laminée comprenant un canal de nettoyage (12) à travers lequel ladite barre se déplace, un moyen (14) pour introduire une solution de nettoyage possédant des composants volatiles dans le canal (12) en contact avec la surface métallique de la barre, un moyen d'essuyage à air (17) en aval du canal (12) pour essuyer la solution de la surface de la barre avec un souffle d'air, un moyen (18) pour collecter la solution essuyée de la surface de la barre, un réservoir (20) pour stocker la solution collectée, et un moyen de drainage (38, 40; 19) pour drainer la solution à partir du moyen de collecte (18) dans le réservoir (20),

caractérisé par un moyen de capture (19) disposé dans le moyen de drainage pour empêcher l'air de s'écouler à partir du moyen d'essuyage à air (17, 18; 36) vers le réservoir (20) et d'emporter les composants volatiles de la solution de nettoyage dans le réservoir (20).

12. L'appareil (10) de la revendication 11, dans lequel ledit souffle d'air comprend de l'air à une pression allant d'environ 1 bar (≈ 1 atmosphère) à environ 10 bars (≈ 10 atmosphères).

13. L'appareil (10) de la revendication 11, dans lequel ladite barre métallique est une barre en cuivre.

14. L'appareil (10) de la revendication 11, dans lequel ladite solution de nettoyage est de l'alcool aqueux.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AIR
TO COILER
10

FIG. 1

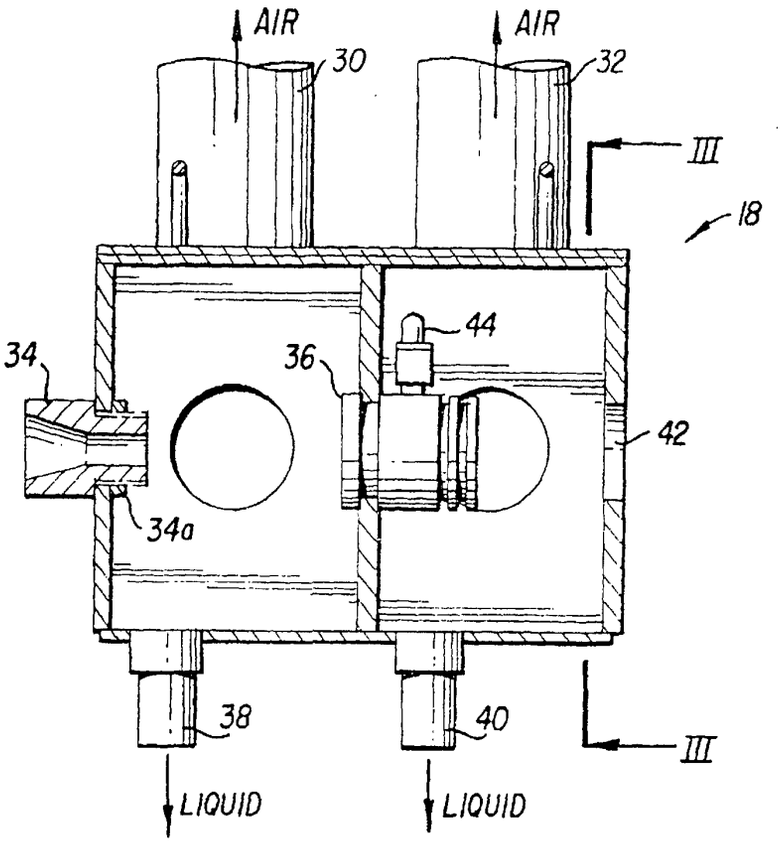
AIR
AIR
30
32
III
18
44
34
36
42
34a
38
40
III
LIQUID
LIQUID

FIG. 2

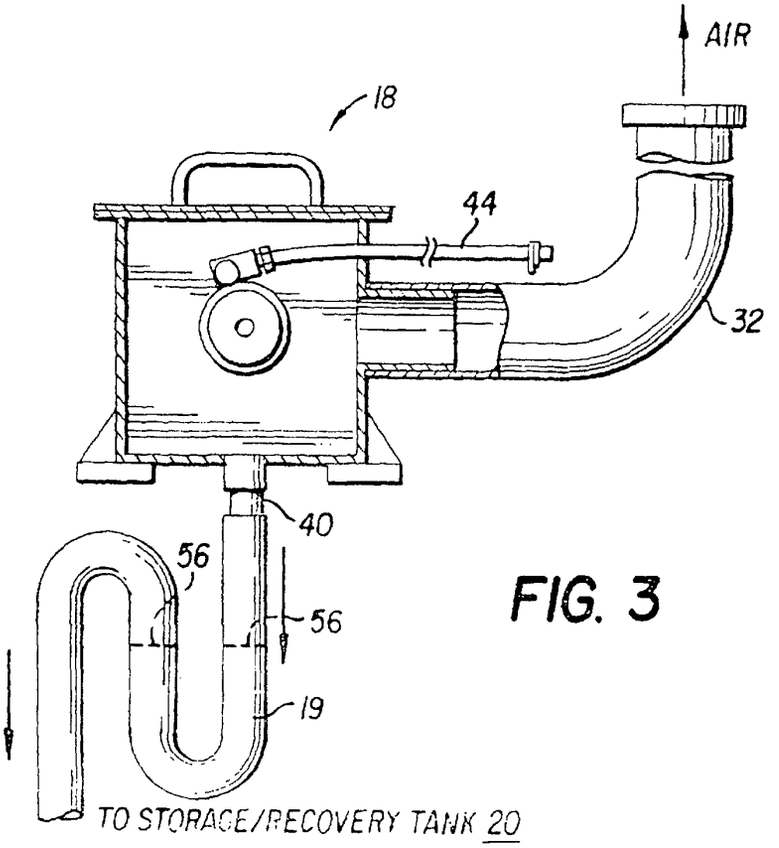
AIR
18
44
32
40
56
56
19
TO STORAGE/RECOVERY TANK 20

FIG. 3