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PROCESS AND APPARATUS FOR THE CONTINUOUS PRODUCTION OF A LITHOGRAPHIC SURFACE

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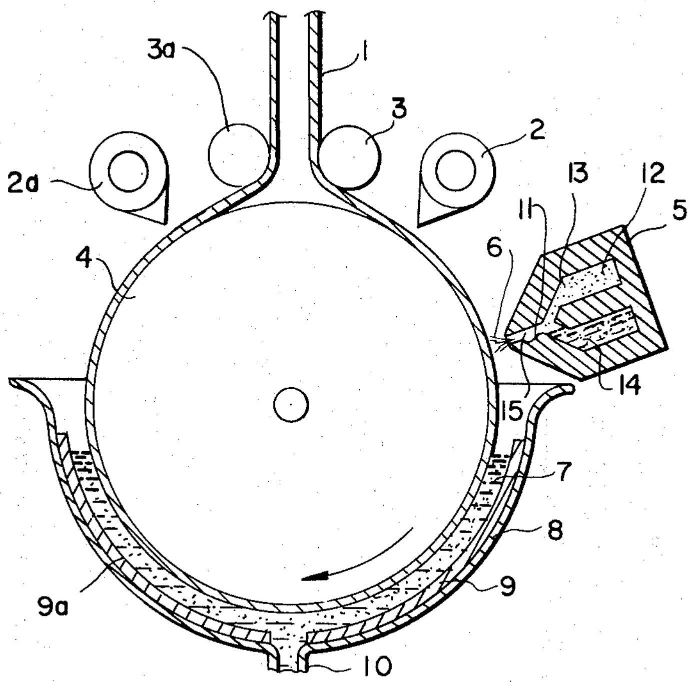

FIG. 1

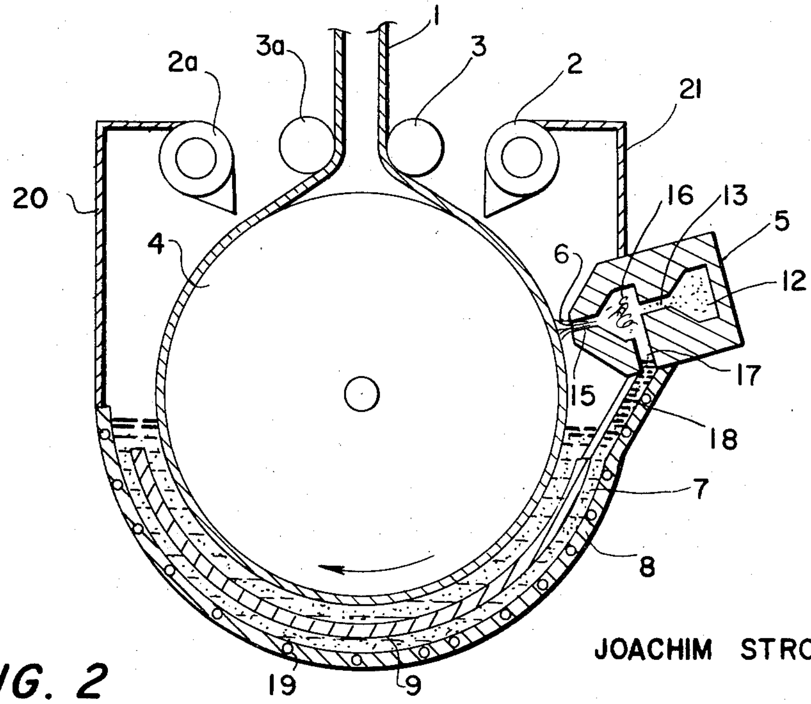

FIG. 2

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PROCESS AND APPARATUS FOR THE CONTINUOUS PRODUCTION OF A LITHOGRAPHIC SURFACE

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U.S. Cl. 204—32 R 4 Claims

ABSTRACT OF THE DISCLOSURE

This invention relates to a process and apparatus for the continuous production of a lithographic surface on a metal strip by wet grinding and electro-chemical treatment in an electrolyte. In the process, the electrolyte is employed for wetting during grinding, and electro-chemical treatment and grinding are performed immediately following each other.

This invention relates to the production of a lithographic surface by grinding, followed or preceded by an electro-chemical treatment.

It is well known that, in most cases, metal plates or foils, e.g. aluminum or zinc plates or foils, which are to be used as lithographic printing plates, must be specially treated on their printing surfaces in order to impart to them particular properties which render them suitable for the intended purpose. The surfaces treated in this manner are designated as "lithographic surfaces."

Normally, this special treatment of the surface includes a graining process, i.e. a roughening of the surface. This may be effected, inter alia, by means of grinding processes in which grinding is effected by brushes, preferably rotating steel brushes or rotating sponges containing abrasive grains in their sponge mass. Normally, a wet grinding process is performed, i.e. the brushes or sponges and the surface to be ground are wetted during the grinding process. Among other advantages, this serves the purpose of binding or washing away the grinding dust produced and of carrying off the heat generated during grinding. Normally, water is used for wetting the grinding tools and the object to be ground.

In some cases, the process for the production of the lithographic surface includes also an electro-chemical treatment in an electrolyte. This treatment may consist, for example, of an oxidation of the surface of an aluminum strip. An oxidation treatment may have the purpose of improving the hydrophilic properties of the aluminum surface, or of closing the pores present in the grained surface, i.e. sealing the surface, or of forming a hard layer of oxide which is very resistant to mechanical abrasion. As another example, the electro-chemical treatment in an electrolyte may have the purpose of electro-depositing on the metal strip a layer of another metal, e.g. a copper layer on an aluminum strip or a chromium or nickel layer on a copper or brass strip, thus producing a bi-metal plate, or a chromium or nickel layer on the copper surface of a copper-plated aluminum strip, thus producing a tri-metal plate.

Both the wet grinding process and the electro-chemical treatments used for the production of lithographic surfaces require a relatively long time, relatively much space, and relatively large quantities of treating agents, and they make it necessary to dispose of relatively large amounts of waste, in particular more or less polluted waste water.

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The present invention provides a process for the continuous production of a lithographic surface, which requires less time and space for its performance, consumes less auxiliaries, and produces less waste.

For achieving these ends, the known process for the continuous production of a lithographic surface on a metal strip by wet grinding and electro-chemical treatment in an electrolyte is used as a basis, and the electrolyte is used for wetting the material during the grinding process. The electro-chemical treatment and grinding immediately follow each other. If the electro-chemical treatment in an electrolyte is an oxidizing process, the electrolyte intended for the electro-chemical oxidation—which may be an aqueous acid bath or an aqueous alkaline bath—is used for wetting the grinding tools and the surface of the metal strip to be ground. If the electro-chemical treatment in an electolyte is an electroplating process, the electrolyte intended for the electroplating process, for example a solution of a copper, chromium or nickel salt, is used for wetting during the grinding process.

Any kind of tools employed in continuously operating devices for roughening a metal strip under wet conditions, e.g. brush rollers or sponge rollers, may be used for the wet grinding according to the invention.

It is particularly advantageous in the process of the invention, when the wet grinding is performed in a manner hitherto unknown, by means of a jet of an abrasive substance. This novel manner of grinding is not alone a part of the present invention, but only in combination with the characteristic feature that the electro-chemical treatment is preformed in an electrolyte and that the electrolyte is also used as a wetting agent during the grinding process. For the novel wet grinding process, which is employed with particular advantage in the process of the invention, a fine-grained abrasive is suspended in the electrolyte, the metal strip is advanced in the direction of the strip during grinding, and grinding is effected by causing the abrasive suspension to impinge upon the travelling strip as a wide jet which extends over the entire width of the metal strip.

Suitable abrasives are, for example, pulverized iron, corundum, aluminum oxide, and other grinding and lapping agents known from grinding and lapping techniques. The grain size of the abrasive depends on the desired effect. For a relatively fine graining, grains of a correspondingly fine size, e.g. 0.01 mm., are selected, and similarly, for a coarser graining, particles of coarser size, e.g. 0.1 mm. In order to produce a roughening of a depth of about 0.002 to 0.004 mm., as is normally desired for aluminum plates, silicon carbide powder of an average grain size of about 0.018 to 0.020 mm. may be used with good results. Further, the depth of roughening obtained depends also upon the energy of impact of the abrasive particles contained in the jet of suspension. Therefore, the speed of impact of the jet suspension onto the strip must be adapted to the desired result, which, when a slot die is used, may be achieved by adjusting the pressure under which the jet of suspension is ejected by the die.

The jet of suspension must be at least as wide as the width of the strip to be grained. Advantageously, a slot die having an orifice of corresponding width is used for producing the jet. The "aperture" of the slot, i.e. the dimension of the slot in the direction of the strip, is normally from 3 to 10 mm. The wider this "aperture," the more effective, under otherwise comparable conditions, is the influence of the abrasive upon the strip, i.e. the faster is the feed speed of the strip at which a particular degree of graining is produced. For practical reasons, however, the maximum values for the slot aperture are limited, because the larger the aperture of the slot die, the more difficult it is to produce a jet having a uniform effect.

The fluid pressure required for achieving a particular effect may be produced and maintained in the slot die by means of a rotary pump, for example. A sufficiently high speed of the wide jet may be produced without employing a high fluid pressure by mixing the suspension of the electrolyte and the abrasive with an expanding gaseous or vaporous medium, preferably compressed air or steam, befor causing it to impinge upon the surface of the metal strip. This method is by far superior to the employment of high fluid pressure. It is performed by means of slot dies which are constructed as mixing nozzles or injector nozzles.

If injector nozzles are used, no pump is necessary. This is a very important advantage, because pumps conveying abrasive suspensions are very quickly worn.

It is also possible for the wide jet of abrasive suspension to be centrifuged by a rotating body and the centrifuged jet to be directed such that it impinges transversely upon the travelling metal strip.

The wide jet of suspension may be directed either vertically or obliquely upon the travelling strip of metal. The arrangement of the jet is determined by the desired effect and depends also upon the other process conditions, such as the impact speed of the jet and the feed speed of the strip. Of course, several wide jets of suspension may be caused to act one after the other upon the travelling metal strip.

In the process according to the invention, the electrochemical treatment in an electrolyte may either precede or follow the wet grinding of the metal strip. If the treatment is an electrolytic oxidation of an aluminum strip, it is performed after grinding the surface of the metal strip. If the electro-chemical treatment is a galvanic metal-deposition, it is normally carried through before the grinding process, and the electro-deposited metal layer is then ground with a suspension of an abrasive in the electrolyte used for depositing the metal layer.

Advantageously, the electrolyte is caused to circulate between the grinding tool and the container in which the electro-chemical treatment takes place. When a substance forming a component of the electrolyte is spent in the process, a quantity of the same substance which replenishes the quantity consumed, may be added to the electrolyte at an appropriate point within the cycle. Correspondingly, waste products which may form in the course of the process may be drained off at a suitable point within the cycle.

In the following, the process will be further illustrated with reference to the accompanying drawings. FIGS. 1 and 2 of the drawings are diagrammatic representations of the most essential parts of two apparatuses suitable for performing the process of the invention.

The apparatus shown in FIG. 1 is used for graining a metal strip **1**, for example an aluminum strip unrolled from a supply roll, not shown in FIG. 1. The strip of material is fed from above to a horizontal drum **4** which is caused to rotate, and is wound around the drum after being deflected to the right hand side by means of a guide pulley **3**. Thereafter, the strip of material is wrapped around almost the entire circumference of the drum **4**. After being lifted from the surface of the drum, the strip of material is deflected upward by means of the guide pulley **3*a***.

During its revolution with the drum, the strip of material **1** is first conducted past an air knife **2**, by which any dust which may be present on the surface to be grained is blown off. Thereafter, a wide, free jet of liquid **6**, of a thickness of several millimeters, ejected by a slot die **5** is caused to impinge on the strip of material across the entire width thereof and transversely to its direction of feed. The wide jet of liquid consists of a suspension of abrasive substances in an electrolyte suitable for the electro-chemical oxidation of aluminum surfaces, e.g. a dilute aqueous

solution of sulfuric acid or nitric acid. By means of the slot die **5**, the wide jet **6** loaded with the abrasive is evenly distributed over the entire width of the strip of material. The abrasive is kept suspended by mixing the abrasive suspension. Whether it is sufficient to mix the abrasive suspension outside of the die **5**, or whether it also must be mixed within the die, depends on the kind of abrasive suspension used and the construction of the slot die, and also on other factors. Detailed statements are not necessary, however, since the preparation of suspensions and methods for keeping them suspended are known and are no part of the present invention.

The drum **4** and the strip of material **1** thereon pass through a trough **8** which surrounds the lower part of the drum and in which the abrasive suspension **7** dripping from the strip of material is collected.

Within the trough **8**, the aluminum strip passes electrodes **9** and **9*a*** which surround it at a short distance, e.g. up to 10 cm. They are connected to one of the poles of a source of current (not shown in FIG. 1). The counter-electrode connected to the other pole of the source of current may be the die or the drum **4**. If the desired electro-chemical oxidation is an anodic oxidation, the die or the drum represent the counter-electrode and are connected to the anode of a direct-current source, while the electrodes **9** and **9*a*** serve as cathodes. The deepest part of the trough **8** is provided with a drain pipe **10** through which the abrasive suspension is drained off at a rate such that the suspension **7** contained in the trough **8** reaches to the desired level. The drained suspension is advantageously circulated back to the die **5**, if necessary after spent substances have been replenished and waste products removed.

After leaving the trough **8**, the web of material is blown off by means of a second air knife **2*a*** in order to remove any traces of abrasive suspension still adhering thereto. The constant circulation of the abrasive suspension from the die **5** to the trough **8** and back through the drain pipe **10** is normally sufficient to keep the abrasive suspended in the suspension.

If the intended electro-chemical treatment is an electro-deposition of a metal layer and the deposited metal layer is to be subsequently ground, the strip of metal is caused to pass through the apparatus in the opposite direction, so that it is conducted past the die **5** after leaving the trough **8**.

If the slot die used in the process is a mixing nozzle, as for example in the embodiment shown in FIG. 1, the mixing channel of the mixing die is advantageously equipped with a whirling niche **11** (see FIG. 1). The niche is arranged such that the ribbon of air issuing from the air chamber **12** of the mixing die through the wide-slotted air channel **13** enters the whirling niche **11** after fusion with the ribbon of electrolyte/abrasive suspension pumped through the wide-slotted suspension channel **14**, and is whirled up therein before the jet consisting of air with the electrolyte/abrasive suspension suspended therein emerges from the slot **15** of the die **5**. In the stretch of the slot die extending between the orifice of the slot **15** and the niche **11**, the suspension is accelerated. The length of the accelerating distance must be at least equal to the "aperture" of the slot.

If the slot die used for the process is an injector nozzle, as for example in the embodiment shown in FIG. 2, the injector nozzle may be of the construction shown in FIG. 2. The body of the die **5** contains an air chamber **12** with a wide-slotted air channel **13** through which a ribbon of air is blown into a funnel-type converging groove **16**, which ends in a wide-slotted orifice **15**. At its wide end, the funnel-type groove **16** is connected over a wide-slotted suction channel **17** with a wide dipping channel **18** which dips into the abrasive suspension. When a ribbon of air issuing from the wide-slotted air channel **13** streams past the wide-slotted suction channel **17**, a certain amount of electrolyte/abrasive suspension contained in the trough **8** is entrained due to the Venturi effect. In the case of an injector nozzle, the accelerating distance extending between the point of the funnel-type groove of the narrowest cross-section and the wide-slotted orifice **15** of the die must also have a certain minimum length, which can be determined by tests. The known hole-type injector nozzles of corresponding cross-section also have this accelerating distance.

In the apparatus shown in FIG. 2, the wall of the trough **8** is provided with channels **19**, through which cooling water is conducted in order to lead off the heat generated during an electrolytic treatment. The apparatus is sealed off from the surroundings by the walls **20** and **21** which mainly serve the purpose of preventing the sprayed abrasive suspension from escaping.

In a simpler embodiment of the process which is, however, sufficient for lower working speeds, normal hole-type nozzles of circular cross-section may be used. Such dies must be oscillated across the width of the strip of material while it is being ground. It is also possible for several hole-type mixing nozzles to be arranged side by side. For faster operating speeds and higher demands regarding uniformity, however, the above mentioned slot dies are more suitable.

The process of the invention has the advantage that it requires less space, can be performed at a higher speed, and causes less waste products than known processes yielding comparable results. The operating speed of the process is caused in particular by the application of the grinding process, which is described above as being preferred. This grinding process results also in more uniformly grained products. The use of this grinding method for the process of the invention has the further advantage that, besides grinding and subsequent oxidation of aluminum strips, normally no further process step is required for degreasing the aluminum strip, because the grinding process causes a satisfactory degreasing of the metal strip. In all its embodiments, the process of the invention has the advantage that it is not necessary to separate the wet grinding agent from the electrolyte, so that a cleaning of the strip of material between the grinding step and the electro-chemical treatment can be omitted.

Electro-chemically oxidizing the aluminum strip immediately following the wet grinding process has the further advantage that no grinds can deposit on the surface roughened by grinding. Further, disturbances of the oxidation process by the action of the ambient atmosphere can be

easily avoided, so that a very uniform oxide formation is achieved.

If the electro-chemical treatment is employed for the purpose of electrolytically roughening aluminum that has already been roughened by grinding, an additional degreasing of the aluminum strip can also be dispensed with in most cases, since the electrolyte used for the electro-chemical roughening is uniformly incorporated in the surface of the metal strip during the grinding process.

It will be obvious to those skilled in the art that many modifications may be made within the scope of the present invention without departing from the spirit thereof, and the invention includes all such modifications.

What is claimed is:

1. In the process for the continuous production of a lithographic surface on a metal strip by wet grinding and electro-chemical treatment in an electrolyte, the improvement which comprises employing the electrolyte for wetting during the grinding process, and performing the electro-chemical treatment and grinding immediately following each other.

2. A process according to claim **1** in which the electro-chemical treatment is performed immediately after grinding.

3. A process according to claim **1** in which a finely divided abrasive material is suspended in the electrolyte and, for grinding, the suspension of abrasive material is impinged upon the moving strip as a jet extending over the entire width of the strip.

4. A process according to claim **3** in which the abrasive suspension is mixed with an expandable fluid medium before it is impinged on the strip.

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JOHN H. MACK, Primary Examiner

R. J. FAY, Assistant Examiner

U.S. Cl. X.R.

51—319; 96—86; 204—17, 28, 33, 36, 209, Dig. 10

UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,691,030 Dated September 12, 1972

Inventor(s) Joachim Stroszynski

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 1, line 7, the following should be added: --- assignor to Kalle Aktiengesellschaft, Wiesbaden-Biebrich, Germany ---.

Column 3, line 10, "for" should read --- fore ---.

Signed and sealed this 3rd day of April 1973.

(SEAL)
Attest:

EDWARD M.FLETCHER,JR.
Attesting Officer

ROBERT GOTTSCHALK
Commissioner of Patents

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