

Monica Sarmiento

Search history

Search 1: TAC=(titanium) (Results 100000)
Search 2: TAC=(hardening) (Results 100000)
Search 3: TAC=(1 and 2) and CPC=(c23c) (Results 331)
Search 4: TAC=((liquid* o fluid*) and transfer) and CPC=(c23c) (Results 0)
Search 5: TAC=((liquid* o fluid*) and transfer) (Results 3)
Search 6: TAC=((liquid* or fluid*) and transfer) (Results 100000)
Search 7: TAC=(3 and 6) (Results 9)

Title: Method and apparatus for controlling heat **transfer** between a container and workpieces

Abstract: Source: US5303904A An apparatus for **transferring** heat between workpieces and a container (10, 10A). The container (10, 10A) has particulate material (28) occupying a substantial portion of the volume of the container (10, 10A) and the container (10, 10A) is rotated to **fluidize** the particulate material which contacts the workpieces (30) for **transferring** heat between the container (10, 10A) and the workpieces (30). The container (10, 10A) is enclosed to provide a sealed volume within the container (10, 10A). A predetermined gas may be provided through an inlet (17, 31A) to the container (10, 10A) and gas may be exhausted from an outlet (16, 133A) from the container (10, 10A). The container may either be heated or cooled as desired.

Classifications:

International (IPC 8-9): B05C19/02 B05D1/24 C21D1/53 C21D1/62 C21D1/74 C23C14/08 C23C8/10 C23C8/24 C23C8/28 (Advanced/Invention)

International (IPC 1-7): B05C19/02 B05D1/24 C21D1/06 C21D1/53 C21D1/62 C21D1/74 C22B1/10 C23C14/08 C23C14/10 C23C8/10 C23C8/28 F27B15/00

CPC: C21D1/53 C21D1/62 C23C8/10 C23C8/24 C23C8/28

European: C21D1/53 C21D1/62 C23C8/10 C23C8/24 C23C8/28

US: 148/209 148/223 148/238 148/276 148/281 148/284 148/630 266/172 266/252 266/257 432/58

Family:

Publication number	Publication date	Application number	Application date
AT191752 E	20000415	AT19930913823T	19930511
CA2117069 AA	19940304	CA19922117069	19920722
CA2117069 C	20040706	CA19922117069	19920722
CA2139752 AA	19950106	CA19932139752	19930511
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DE69328375 T2	20001221	DE19936028375T	19930511
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US5303904 A	19940419	US19920911062	19920709
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US5407498 A	19950418	US19930144659	19931102
WO9306257 A1	19930401	WO1992US06088	19920722
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Priority:

US19900467050	19900118	US19910763339	19910920	WO1992US06088	19920722
WO1993US04390	19930511	US19920960830	19921014	US19920911062	19920709
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Probable Assignee: FIKE CORP

Assignee(s): (std): FIKE CORP ; KEMP DEV CORP ; KEMP WILLARD E

Assignee(s): KEMP DEVELOPMENT CORP ; FIKE CORP BLUE SPRINGS

Inventor(s): (std): KEMP WILLARD E

Agent(s): RIDOUT AND MAYBEE LLP

Designated states: AT BE CA CH DE DK ES FR GB GR IE IT JP LI LU MC NL NO PT SE

Title: SURFACE

Abstract: Source: US2015010733A A process for producing a fluid transfer surface, which process comprises: providing a titanium or titanium alloy surface; subjecting the titanium or titanium alloy surface to surface hardening by interstitial element absorption to provide a hardened surface; and, if required engraving the hardened surface to provide a desired surface topography.

Classifications:

International (IPC 8-9): B05C21/00 B29C33/38 B29C33/42 B41C1/05 B41M99/00 B41N1/16 B41N7/00 B41N7/06 C23C24/04 C23C26/00 C23C8/02 C23C8/06 C23C8/16 C23C8/20 C23C8/24 C23C8/34 C23C8/80 (Advanced/Invention); B05C B41M B41N C23C (Subclass/Invention)
IPC: C23C8/34 C23C8/80 C23C8/24 C23C24/04 B41N7/005 B41N7/06 B41N2207/02 B41N2207/10 C23C8/02 Y10T29/49746 Y10T29/49995 Y10T428/24479
US: 101/483 29/402.18 29/557 428/156

Image not currently available

Family:

Publication number	Publication date	Application number	Application date
AU2013218795 AA	20130815	AU20130218795	20130208
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Priority:
AU20120900479 20120209 WO2013AU00114 20130208 AU20130218795 20130208

Probable Assignee: COMMW SCIENT IND RES ORG

Assignee(s): (std): COMMW SCIENT AND IND RES OR ; COMMW SCIENT IND RES ORG

Assignee(s): COMMW SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANISATION ; COMMW SCIENTIFIC AND INDUSTRIAL RESEARCH OR ; KING PETER CHRISTOPHER ; HOLLAND JUSTIN PATRICK ; JAHEDI MAHNAZ ZEHTAB ; SHI YU HE ; ENGEL ALEXANDER CARL ; COMMW SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANISATIONLIMESTONE AVENUEAUSTRALIAN CAPITAL TERRITORY, 2612CAMPBELLAU ; COMMW SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANISN

Inventor(s): (std): ALEXANDER CARL ENGEL ; ENGEL ALEXANDER CARL ; HOLLAND JUSTIN PATRICK ; JAHEDI MAHNAZ ZEHTAB ; JUSTIN PATRICK HOLLAND ; KING PETER CHRISTOPHER ; MAHNAZ ZEHTAB JAHEDI ; PETER CHRISTOPHER KING ; SHI YU HE ; YU HE SHI

Inventor(s): SHI YU HEAU ; KING PETER CHRISTOPHERAU ; JAHEDI MAHNAZ ZEHTABAU ; HOLLAND JUSTIN PATRICKAU ; ENGEL ALEXANDER CARLAU

Agent(s): MARKS AND CLERK AUSTRALIA; DAVIES COLLISON CAVE; GRIFFITH HACK; MARKS AND CLERK; SILVANA MARIA LOPEZ DIAZ; CHAPMAN PAUL GILMOUR; YAMAMOTO OSAMU; TAKEUCHI SHIGEO; ONO SHINJIRO; MATSUYAMA MINAKO; KOBAYASHI YASUSHI; CURWEN JULIAN CHARLES BARTON ET AL

Designated states: AE AG AL AM AO AT AU AZ BA BB BE BF BG BH BJ BN BR BW BY BZ CA CF CG CH CI CL CM CN CO CR CU CY CZ DE DK DM DO DZ EC EE EG ES FI FR GA GB GD GE GH GM GN GQ GR GT GW HN HR HU ID IE IL IN IS IT JP KE KG KM KN KP KR KZ LA LC LI LK LR LS LT LU LV LY MA MC MD ME MG MK ML MN MR MT MW MX MY MZ NA NE NG NI NL NO NZ OM PA PE PG PH PL PT QA RO RS RU RW SC SD SE SG SI SK SL SM SN ST SV SY SZ TD TG TH TJ TM TN TR TT TZ UA UG US UZ VC VN ZA ZM ZW

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Priority:

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Probable Assignee: MICROCONTINUUM INC

Assignee(s): (std): FREY TIMOTHY ; FREY TIMOTHY J ; KIME MILFORD ; MICROCONTINUM INC ; MICROCONTINUUM INC ; SLAFER W DENNIS ; WHITE MATTHEW B ; SLAFER W D ; WHITE MATTHEW ; SLAFER DENNIS W ; MICROCONTINUUM INC

Assignee(s): SLAFER W

Inventor(s): (std): FREY TIMOTHY ; FREY TIMOTHY J ; KIME MILFORD ; SLAFER DENNI W ; SLAFER DENNIS W ; SLAFER W D ; SLAFER W DENNIS ; WHITE MATTHEW ; WHITE MATTHEW B

Inventor(s): SLAFER W

Agent(s): RICHES MCKENZIE AND HERBERT LLP; G RONALD BELL AND ASSOCIATES; HILL JUSTIN JOHN ET AL; MUELLER BORE AND PARTNER PATENTANWALTE PARTG MBB; MCDERMOTT WILL AND EMERY LLP, ATTN: INTELLECTUAL PROPERTY DEPARTMENT; MCDERMOTT WILL AND EMERY LLP ATTN INTELLECTUAL PROPERTY DEPTARTMENT; MCDERMOTT WILL AND EMERY LLP; KUSMER TOBY H ET AL; KUSMER TOBY H

Designated states: AE AG AL AM AO AT AU AZ BA BB BE BF BG BH BJ BR BW BY BZ CA CF CG CH CI CM CN CO CR CU CY CZ DE DK DM DO DZ EC EE EG ES FI FR GA GB GD GE GH GM GN GQ GR GT GW HN HR HU ID IE IL IN IS IT JP KE KG KM KN KP KR KZ LA LC LI LK LR LS LT LU LV LY MA MC MD ME MG MK ML MN MR MT MW MX MY MZ NA NE NG NI NL NO NZ OM PG PH PL PT RO RS RU SC SD SE SG SI SK SL SM SN ST SV SY SZ TD TG TJ TM TN TR TT TZ UA UG US UZ VC VN YU ZA ZM ZW

Title: METHODS OF FORMING METAL LAYERS USING METALLIC PRECURSORS

Abstract: Source: US2003017697A Methods of forming metal layers include techniques to form metal layers using atomic layer deposition techniques that may be repeated in sequence to build up multiple atomic metal layers into a metal thin film. The methods include forming a metal layer by chemisorbing a metallic precursor comprising a metal element and at least one non-metal element that is ligand-bonded to the metal element, on a substrate. The metal element may include tantalum. The chemisorbed metallic precursor is then converted into the metal layer by removing the at least one non-metal element from the metallic precursor through ligand exchange. This removal of the non-metal element may be achieved by exposing the chemisorbed metallic precursor to an activated gas that is established by a remote plasma, which reduces substrate damage. The activated gas may be selected from the group consisting of H₂, NH₃, SiH₄ and Si₂H₆ and combinations thereof. These steps may be performed at a temperature less than about 650 degrees centigrade

Classifications:

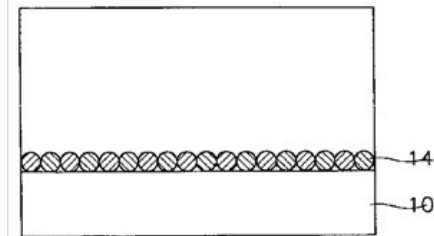
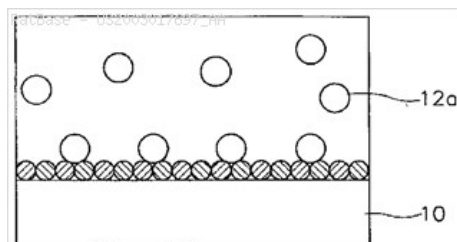
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International (IPC 1-7): B01J13/02 B05D3/00 B05D5/12 B60J5/06 C23C16/00 C30B1/00 H01L21/00 H01L21/20 H01L21/28 H01L21/3205 H01L21/336 H01L21/36 H01L21/44 H01L21/4763 H01L21/8234 H01L21/8238 H01L21/8242 H01L21/8244 H01L21/84 H01L23/48 H01L27/092 H01L27/108 H01L29/76 H01L29/78 H04J11/00 H04L25/49 H04L27/26

CPC: H01L29/792 H01L27/10817 H01L27/10852 H01L27/115 H01L27/11568 H01L28/91 H01L29/513 C23C16/34 C23C16/45542 C23C16/45553 H01L21/28562 H01L21/318 H01L27/10814 H01L27/10855 H01L27/10888 H01L28/90 C23C16/36 H01L21/28088 H01L21/28556 H01L21/76843 H01L21/76856 H01L29/4966 H01L29/66583 H01L21/28194 H01L29/517 H01L29/6656 H01L29/6659 H01L29/7833 C23C16/56 H01L21/265 H01L21/76841 H01L21/76858 H01L21/76862 H01L21/76867 H01L21/76877 H01L21/28185 H01L21/28202 H01L21/82345 H01L29/518 H01L21/32051 H01L2924/0002 H01L21/7685 H01L21/76802 H01L23/53223 H01L23/53266 H01L21/0215 H01L21/28282 H01L21/823857 H01L21/823842 H01L21/823425

European: C23C16/34 C23C16/36 C23C16/455F2B8F C23C16/455F2H C23C16/56 H01L21/265 H01L21/285B4H H01L21/285B4H2 H01L21/28E2B6 H01L21/28E2C2 H01L21/28E2C2C H01L21/28E2C2D H01L21/28E2C2N H01L21/318 H01L21/768B2 H01L21/768C3 H01L21/768C3B H01L21/768C3C H01L21/768C3D2D H01L21/768C3D4B H01L21/768C3F H01L21/768C4 H01L21/8234D2 H01L21/8234G4 H01L21/8238G4 H01L23/532M1A4 H01L23/532M1R4 H01L27/108M4B2 H01L27/115 H01L27/115G4 H01L29/49E H01L29/51B H01L29/51B2 H01L29/51M H01L29/51N H01L29/66M6T6F10 H01L29/66M6T6F11B2 H01L29/66M6T6F11B3 H01L29/78F H01L29/792 M23C16/44E12 T01L21/285B4H T01L21/768C3 T01L21/768C3B T01L21/768C3D2B T01L21/8238J T01L27/108F2C T01L27/108F2M T01L27/108M4B2C T01L27/108M4D4 T01L28/90 T01L28/91 T01L29/66M6T6F10 T01L29/66M6T6F11B3 T01L29/78F

US: 118/723R 204/192.17 204/298.02 257/412 257/412P 257/413 257/413S 257/750 257/751 257/753 257/761 257/763 257/765 257/774 257/774P 257/E21.018 257/E21.018S 257/E21.17 257/E21.170S 257/E21.171 257/E21.171S 257/E21.193 257/E21.204 257/E21.204S 257/E21.292 257/E21.292S 257/E21.295 257/E21.295S 257/E21.334 257/E21.334S 257/E21.434 257/E21.434S 257/E21.577 257/E21.577S 257/E21.584 257/E21.584S 257/E21.585 257/E21.585S 257/E21.62 257/E21.620S 257/E21.623 257/E21.637 257/E21.637S 257/E21.639 257/E21.639S 257/E21.649 257/E21.649S 257/E21.658 257/E21.658S 257/E21.679 257/E21.679S 257/E23.16 257/E23.160S 257/E27.088 257/E27.088S 257/E27.103 257/E27.103S 257/E29.16 257/E29.160S 257/E29.165 257/E29.266 257/E29.266S 257/E29.304 257/E29.304S 257/E29.309 257/E29.309S 427/248.1 427/248.100P 427/255.28 427/255.394 427/96 427/96.8 427/97.2 427/98.8 438/197 438/199 438/216 438/218 438/218P 438/231 438/253 438/253P 438/267 438/275 438/283 438/314 438/314P 438/396 438/396S 438/584 438/585 438/585S 438/587 438/588 438/592 438/597 438/597P 438/620 438/627 438/627P 438/628 438/629 438/629S 438/643 438/643P 438/644 438/644S 438/648 438/653 438/653P 438/653S 438/654 438/654S 438/656 438/656S 438/659 438/679 438/679P 438/680 438/680S 438/681 438/681P 438/681S 438/682 438/682S 438/685 438/685S

**Family:**

Publication number	Publication date	Application number	Application date
CN100563229 C	20091125	CN200410049819	20040625
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Priority:

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US20040877848	20040625	KR20030042844	20030627	US20050046624	20050128
US20040857253	20040528				

Probable Assignee: SAMSUNG ELECTRONICS CO LTD

Assignee(s): (std): CHO HAG JU ; CHOI GIL HEYUN ; CHOI KYUNG IN ; JEON TAEK SOO ; KANG SANG BOM ; LEE JONG HO ; SAMSUNG ELECTRONICS CO LTD ; LEE YOU KYOUNG ; PARK SEONG GEON ; LEE JONG MYEONG ; LEE SANG WOO ; KIM BYUNG HEE ; LEE CHANG WON ; LEE HYE LAN ; SHIN YU GYUN ; POLYCHROM CO LTD ; KIA MOTORS CORP

Assignee(s): SAMSUNG ELECTRONICS CO ; KANG SANG BUM

Inventor(s): (std): CHO HAG JU ; CHOI GIL HEYUN ; CHOI GIL HYEON ; CHOI GYEONG IN ; CHOI KYUNG IN ; JEON TAEK SOO ; KANG SANG BEOM ; KANG SANG BOM ; KANG SANG BUM ; KIM BYEONG HUI ; KIM BYUNG HEE ; KWON YONG SIK ; LEE CHANG WON ; LEE HYE LAN ; LEE JONG HO ; LEE JONG MYEONG ; LEE SANG U ; LEE SANG WOO ; LEE YOU KYOUNG ; LEE YU GYEONG ; PARK JAE HYEON ; PARK SEONG GEON ; SHIN YU GYUN ; YANG SI YEONG ; YONG SIK KWON ; YOUNGSIK KWON

Inventor(s): KWON YOUNGSIK

Agent(s): MARGER JOHNSON AND MCCOLLOM PC; MYERS BIGEL SIBLEY AND SAJOVEC; JARETT K ABRAMSON MYERS BIGEL SIBLEY AND SAJOVEC PA; MYERS BIGEL SIBLEY AND SAJOVEC PA

Title: Surface **hardening** of **titanium** alloys with melting depth controlled by heat sink

Abstract: Source: US5455079A A process for forming a hard surface coating on **titanium** alloys includes providing a piece of material containing **titanium** having at least a portion of one surface to be **hardened**. The piece having a portion of a surface to be **hardened** is contacted on the backside by a suitable heat sink such that the melting depth of said surface to be **hardened** may be controlled. A **hardening** material is then deposited as a slurry. Alternate methods of deposition include flame, arc, or plasma spraying, electrodeposition, vapor deposition, or any other deposition method known by those skilled in the art. The surface to be **hardened** is then selectively melted to the desired depth, dependent on the desired coating thickness, such that a molten pool is formed of the piece surface and the deposited **hardening** material. Upon cooling a **hardened** surface is formed.

Classifications:
International (IPC 8-9): B23K35/32 C23C26/02 C23C4/18 (Advanced/Invention)
International (IPC 1-7): C23C16/00
CPC: B23K35/325 C23C4/18 C23C26/02
European: B23K35/32C C23C26/02 C23C4/18
US: 148/522 205/224 205/228 228/222 228/50 427/250 427/318 427/450 427/508 427/540 427/559 427/569

Family:

Publication number	Publication date	Application number	Application date
US5455079 A	19951003	US19950380918	19950131

Priority:

US19910736344 19910726	US19940233552 19940505	US19950380918 19950131
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Probable Assignee: US ARMY

Assignee(s): (std): US ARMY

Assignee(s): THE UNITED STATES OF AMERICA AS REPRESENTED BY THE ; THE UNITED STATES OF AMERICA AS REPRESENTED BY THE SECRETARY OF THE INTERIOR

Inventor(s): (std): ODEN LAURANCE L ; TURNER PAUL C

Title: INDUSTRIAL VAPOR CONVEYANCE AND DEPOSITION

Abstract: Source: US2003041801A A process for deposition and condensation and reaction and separation and distillation employing at least two chambers separated by a diaphragm with at least one separation wall and at least one orifice or flow duct or plurality thereof, said process providing a controlled and stationary conveyance capacity of an uncondensed intermediary phase for a product or by-product with a controlled concentration, structure or microstructure, for example, said conveyance capacity relying on a controlled pressure of an atmosphere in the at least two chambers on both side of said diaphragm and on a novel diaphragm and condenser technology and a temperature control of one or more chamber walls or said diaphragm or parts of said diaphragm being transversed by said uncondensed intermediary phase. For a given pressure (difference) in the at least two chambers, surface roughness and form (such as cross and transverse section including widening, nozzle, funnel, flow and guide elements, heat exchanger, bifurcation and bend) and geometry including form and size of such structural part components of an orifice or flow duct or a combination of them affect the driving force for the resulting rate of conveyance and, for a given conveyance capacity, the resulting rate of deposition or condensation or reaction or separation or distillation via said uncondensed intermediary phase per orifice or flow duct. The new process includes (i) a condensation-free formation of a reservoir of an uncondensed phase under controlled flow conditions in front of a diaphragm, (ii) local pulse forces in an orifice or flow duct being controlled by local flow speed or local flow density or local flow pressure of said uncondensed phase to provide macroscopic control of an uncondensed intermediary and final phase or material and (iii) controlled conveyance and production rates under conditions of said local control and being independent from gravitational acceleration so orientation of individual modules or units or assembly of a production plant.

Classifications:

International (IPC 8-9): C22C21/00 C22C23/00 C22C23/06 C22C45/00 C23C14/14 C23C14/22 (Advanced/Invention);

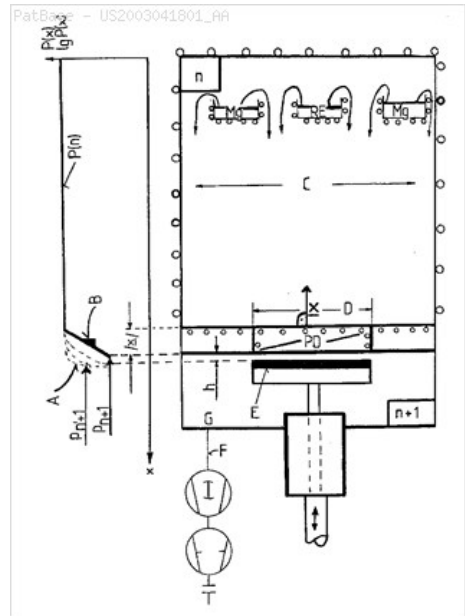
C22C21/00 C22C23/00 C22C45/00 (Advanced/Non-invention)

International (IPC 1-7): C22C21/00 C22C23/00 C22C23/06 C22C45/00 C22F3/00 C23C14/14 C23C14/22 C23C14/54 C23C16/00 F15D1/02

CPC: Y10T137/85938 C23C14/22 C23C14/14 Y02T50/67

European: C23C14/14 C23C14/22 Y02T50/67

US: 118/715 118/718 118/718S 118/723 118/723VE 137/561.00A 137/561A 138/38 138/38S 138/4 138/40 138/40S 138/42 138/44 148/404 148/406 148/42 148/420 148/420S 148/437 148/437S 148/666 148/667 420/402 420/407 420/407S 427/248.1 427/248.100S 427/255.5 95/45 96/4



Family:

Publication number	Publication date	Application number	Application date
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US2003041801 AA	20030306	US20010766644	20010123
US2003183306 AA	20031002	US20020265467	20021007
US6248399 BA	20010619	US19970776381	19970303
US6544357 BA	20030408	US19970776382	19970131
US6908516 BB	20050621	US20020265467	20021007
US6941973 BB	20050913	US20010766644	20010123
WO9604409 A1	19960215	WO1995EP02882	19950719
WO9604410 A1	19960215	WO1995EP03076	19950731

Priority:

EP19940111991 19940801	EP19950926967 19950719	WO1995EP02882 19950719
EP19950944461 19950731	WO1995EP03076 19950731	US20010766644 20010123
US19970776381 19970303	US20020265467 20021007	US19970776382 19970131

Probable Assignee: HEHMANN FRANZ IBURGER STRASSE

Assignee(s): (std): FRANZ HEHMANN ; HEHMANN FRANZ ; HEHMANN FRANZ DR ; WEIDEMANN MICHAEL

Assignee(s): HEHMANN FRANZ IBURGER STRASSE

Inventor(s): (std): FRANZ HEHMANN ; HEHMANN FRANZ ; HEHMANN FRANZ DR ; MICHAEL WEIDEMANN ; WEIDEMANN MICHAEL

Agent(s): FOLEY AND LARDNER LLP; FOLEY AND LARDNER

Designated states: AT AU BE CA CH CN DE DK ES FR GB GR IE IT JP KR LI LU MC NL PT RU SE US

Title: CONTINUOUS DIFFUSION COATING

Abstract: Source: US3824122A ABSTRACT OF THE DISCLOSURE Workpieces are diffusion coated by packing them singly in individual snugly fitting retorts with a diffusion coating pack, heating the packed retorts to diffusion coating temperature for a time adequate to effect the desired coating, and then rapidly cooling the retorts. The small amount of pack surrounding the workpiece permits very rapid cooling without the need to apply a cooling liquid to, these small retorts, and entire coating operation is accordingly well suited for coating nickel-base superalloys. that should before use be subjected to solution heat treatment and rapid cooling with or without subsequent aging. The diffusion coating can then be conducted under solution heat treating conditions. Tubular retorts can be used. The present invention relates to diffusion coating, and more particularly to the diffusion coating and subsequent rapid cooling of workpieces. Among the objects of the present invention is the provision of novel methods and apparatus for expeditiously diffusion coating and rapidly cooling workpieces. The foregoing as well as additional objects of the present invention will be more fully understood from the following description of several of its exemplifications, reference being made to the accompanying drawings wherein: Fig. 1 is a vertical sectional view of a workpiece packed for subjection to a diffusion coating in accordance with the present invention; Fig. 2 is a similar view of a stage in the preparation of the pack unit of Fig. 1, the workpiece being shown as seen from one side; Fig. 3 is a plan view of one arrangement typical of the present invention for effecting the heat treatment of packed units such as shown in Fig. 1; Fig. 4 is a vertical sectional view of a modified arrangement pursuant to- the present invention for effecting such heat treatment; and FIGS. 5A through 5E are similar views of stages in a modified technique for preparing workpieces for diffusion coating representative of the present invention. According to the present invention workpieces are diffusion coated by providing a retort which is a snug fit all around for the portions of a single workpiece. to be coated, packing those portions of the workpiece, in the retort with a diffusion coating powder pack so that there is at least a little thickness of pack contacting all of said workpiece portions, and then heating the packed assembly to a diffusion coating temperature. After the heat treatment is complete the packed retort cools down very rapid. ly not only because the retort is of minimum size and therefore of high surface-to -volume ratio, but because the thermal insulation effect of the powder in the pack is reduced by reason of the relatively shallow depth of pack between the outer surface of the workpiece and the inner surface of the retort. Thus a cylindrical steel retort having a diameter of 1 1/2 inches when snugly packed with a workpiece which has portions extending to about 1/4 inch from the retort's inner surface, and standing in a tray, will upon removal from a furnace where it has been heated to 2000' F., cool down to about 1000' F. in about 20 minutes. Moreover if a flow of cold flushing gas is permeated through the tray during the cooldown, the 100,0' F. temperature can be reached in about 10 minutes. Such rapid cooling rates are particularly suited for conducting the diffusion coating as a heat treating operation such as is normally practiced with nickel-base superalloys. To develop the maximum strength of such superalloys they are, given a solution heat treatment at 1975 to 2200' F. for a prescribed time, and then rapidly cooled to below about 1200' F. followed by an aging heat treatment at 1200 to 1900' F. The solution heat treatment causes the **hardening** phase to dissolve in the continuous metal phase, and at the rate of at least 15' F., preferably 25' F. or more per minute a cooldown causes the **hardening** phase to precipitate out as very fine particles that give: the greatest **hardening** effect. This is particularly desirable for jet engine blades and vanes where maximum strength is needed at operating temperatures as high as 1600' F. and higher, and even at temperatures higher than the aging temperature. Turning now to the drawings, Fig. 1 shows a workpiece 12 packed in a two-piece retort 10 composed of two cylindrical tubes 11 and 13. A powder diffusion coating pack 16 fills the space around the. upper portion 21 of the workpiece in tube 11, and a powder masking pack 18 fills the space around the lower portion 22 of the workpiece in tube 13. The workpiece is shown as a jet engine blade the upper portion 21 of which is an airfoil and the lower portion 22 a mounting root. A buttress flange 24 separates the upper and lower portions. The blade 12 can for example be made of the nickel base superalloy IN-738 having the following composition: SPercent Carbon ----- .17 Chromium ----- 16.00 Cobalt ----- P.50 Molybdenum ----- 1.75 Tungsten ----- 2.60 Tantalum ----- 1.75 Columbium ----- 0.90 Aluminum ----- 3.40 **Titanium** ----- 3.40 Boron ----- .01 Zirconium ----- 10 Nickel, balance. This alloy achieves its best combination of mechanical properties when heated at 2y0500 F. for two hours, then cooled to below 1000' F. at least as rapidly as is effected,5 by standing in air, then heated to 1550' F. for 24 hours followed by another such fast cooldown to below 100y0' F. The packing arrangement of Fig. 1 is -designed for diffusion coating of a blade airfoil with an essentially aluminum coating, without coating the blade root. Because of the throwing characteristics of such coatings, the root will tend to be coated even though not in contact with the diffusion coating pack. To make sure that no coating whatever reaches the root it is packed in a masking pack that can consist essentially of Ni₃Al diluted with alumina. This 630 or any of the other masking compositions disclosed in Belgian Pat. 752,651 can be used and are particularly desirable inasmuch as they keep the superalloy surface they engage from undergoing changes such as significant loss of alloying ingredients, that could significantly (Sweaken it. One simple technique for effecting the packing of Fig. 1 is illustrated in Fig. 2. The latter figure shows the blade 12 placed on a support plate 30! that has an opening 32 which receives the blade root 22. Buttress 24 rests against the plate and supports the blade in the illustrated position. A cylinder 11 which can be plain carbon steel open at both ends, is slipped over the upstanding airfoil section 21 of the blade and is arranged to be a snug fit so that spaces 26 and 27 between the outer corners of the buttress, which is generally rectangular, and the inner surface of the tube 11 is about 3/16 of an inch. Coating powder is then poured into tube 11 around the airfoil 21 until it fills the tube and preferably piles up somewhat above the tube top. The buttress 24 is arranged to substantially cover opening 32 so that the coating powder does not significantly find its way past plate 30. If desired the powder can then be compacted as by means of a powerdriven ram 34, under a pressure of about 400 pounds per square inch where the powder is of very fine particle size such as finer than 200 mesh. Coating powders of this type are shown in Canadian Pat. 806,618 granted Feb. 18, 1969, as well as in U.S. Pat. 3,2y57,230 granted June 21, 1966. In case the coating powder stands above the top edge of tube 11 after compacting, some can be scraped off if a generally -flat surface is desired. On the other hand if the ram 34 reaches the upper edge of tube 11 before full compacting pressure is developed, the amount of powder is inadequate and the ram can then be retracted, additional powder added to the top of tube 11 and the ramming repeated until the ramming pressure is reached with the ram not quite contacting the upper edge of tube 11. The foregoing compacting step will leave the blade 12 securely held in tube 11 so that the ram can be withdrawn and the tube manipulated as desired without having the powder spill out. Where compacting is not used a cover can simply be placed over the top of tube 11 to keep the powder from spilling. The tube is then turned upside down, placed in upside-down position on support 30 and tube 13 then slipped over the upstanding root 22. Masking powder can then be poured into tube 13 and if desired compacted by the same ram to provide a powder surface as shown in Fig. 1. Tubes 11 and 13 are illustrated in Fig. 1 as of slightly different diameters. While for greater exactness in packing it is helpful to have the sizes so related that one retort tube end is engaged by the other around its entire circumference, that is not essential. So long as any packing pressures used to compact the powder in both tubes are about the same or the second is less than the first, the compacting applied to the second tube will not significantly affect what has been compacted in the first tube even though the second tube has one end in position to 4 penetrate into the powder pack of the first tube or the first tube has its end positioned to penetrate into the powder being compacted in the second tube. It is not necessary to have the outer surfaces of the packed powder flat and level with the mouths of their respective tubes. However such leveling provides a convenient gauge of the thickness of the powder layer between the ambient atmosphere and the nearest portions of the blade. These outermost portions should be covered and handling tolerances make it desirable to have the covering powder layer at least about 1/16 of an inch thick. Such a thickness can be formed with the tubes 11 and/or 13 slightly longer than needed, and the ram 34 shaped so that it is received by the open mouths of the tubes with the compacting effected in such a way that the upper surface of the compacted powder is below the mouths of the tubes. In this type of arrangement it is helpful to have the mouths of both tubes 11 and 13 about the same diameter so that the same ram can be used on both ends of the packing. An alternative packing technique is to use a single tube long enough to receive the entire blade and to loosely fit a supporting block in the tube, near one of its ends, the block having a socket that receives the blade root and faces the other end of the tube. The blade can then be inserted with its root received in the socket in the block, powder 16 packed in while the tube is held with its blockcarrying end on a support that also supports the block. In this condition the powder packed in the tube can be compacted, after which the tube can be lifted away from the support to let the block fall out, and then inverted to receive the packing 18. While cylindrical tubes of circular cross-section are generally most convenient to use, the tubes can have any other cross-section. It is preferred that they snugly fit all around the portions of the blade which they surround since in this way the thickness of the powder pack between the outer surface of the blade and the adjacent inner surface of the tube can be kept small throughout. The thickness can be as much as an inch or so, so long as in at least some portions the thickness is reduced to about 1/4 inch or less. At these locations where the pack thickness is small, **transfer** of heat is very rapid and inasmuch as the blades are metallic the entire body of the blade will rapidly cool even where only the four corners of the buttress are thermally insulated by 1/4 inch of powder pack. A cylindrical tube of circular cross-section is accordingly perfectly adequate. Indeed the leading and trailing edges of the airfoil would generally be only 1/2 to 1/4 inch farther away from the inner surface of the surrounding tube than the buttress corners are. Inasmuch as the diffusion coating powder as well as the masking powder generally contain as much as 50 percent or more inert materials such as aluminum oxide or kaolin in order to reduce the danger of having particles of the pack sinter against workpiece surfaces, these powders have a relatively high thermal insulating effect. The heat **transfer** through such powders is accordingly much slower than it is through metal and even through air or other gases. The "snug fit" in a retort is defined as such a packing as to cause cooling of a packed workpiece to take place at the rate of at least 150 F. per minute when the retort at 1900' F. is placed in still air. Retorts having a volume of as much as 1/2s cubic foot will show such rapid cooling. For greater effectiveness however the tubes can be cylinders of oval or rectangular cross-section and thus hey even a more snug fit around the blade. Furthermore tubes 11 and 13 can have different cross-sectional shapes and be differently oriented with respect to their workpiece portions, in addition to having different widths. Fig. 3 shows an arrangement by which a batch of assembled retorts as illustrated in Fig. 1, are subjected to the diffusion coating treatment. A tray 40 having a bottom wall 41 and an upstanding marginal side wall 42, is arranged to hold one or two marginal rows of packed retorts 10 with the retorts spaced from each other a small distance. A loosely fitting cover is then applied over the top of the tray walls 42 and the Wray then inserted in a diffusion coating furnace retort 46 having a tightly fitting cover and arranged to maintain the desired atmosphere within the furnace retort. As shown in Belgian Pat. 752,651 the furnace retort can have its cover equipped with gas inlet and outflow tubes through which a flushing gas is passed during the diffusion coating operation. Several trays loaded in the manner illustrated in Fig. 3 can be stacked in such a furnace retort to increase the batch size. The firing is rapidly effected inasmuch as the amount of powder present around each workpiece is exceedingly small. The workpiece temperatures are readily followed by packing a thermocouple in one of the small retorts 10 in place of the workpiece and having the thermocouple leads run past the loosely fitting tray cover and through the furnace retort cover to the outside where the thermocouple signals can be observed. The temperature outside tray 40 can also be monitored and generally a small thermal lag is observed in the heat-up between the temperatures of the workpieces and that of the space around trays 40. After the diffusion coating temperature has been reached and maintained for the desired time, the heating is terminated and the furnace retort withdrawn from the furnace, or in the case of a shell-type

furnace the furnace shell 48 removed from around the furnace retort. Passage of the flushing gas 3)824,122 through the furnace retort after such withdrawal or removal, can be used to speed the cooldown as by arranging for the flushing gas to be cold, that is at ambient temperature, when introduced into the furnace retort. In this way the workpiece temperatures can be brought down from about 20000 F. to about 12000 F. in about ten minutes. However even without the supplemental cooling effect of such flushing gases the cooldown generally takes place in about 30 minutes, a time period well suited to develop maximum strength in the workpieces. After such cooldown the blades still packed in their retorts 10 and still in trays 40 can then be reheated and subjected to a 15500 F. aging for 24 hours followed by another fast cooldown with or without the help of cold flushing gas. Such final fast cooldown is also at the rate of at least 15 and preferably at least 250 F. per minute until the workpiece temperature comes down to about 8000 F. At about 3000 F. the workpiece can be exposed to the atmosphere and removed from their retorts 10. When open-ended individual retorts 10 are used, the workpiece, removal is also greatly facilitated. Two-part retorts are readily separated into their two parts as by tapping or rapping against one of the two retort parts. The contents of whichever retort part the workpiece remains in are readily pushed out by a discharge ram. Pushing of the workpiece out of the retort is facilitated by first loosening a portion of the pack as with a nonmetallic rod. Separation of the two-tube retorts into their individual tubes helps to keep the diffusion coating powder 16 separate from the masking powder 18 so that each can be reused. However the total amount of powder used per workpiece is so relatively small that reuse is not of great importance. Other types of workpieces can be diffusion coated in a manner similar to that described above and the advantages of the rapid cooldown are also obtained when diffusion coating is practiced without masking, as for example where the entire outer surface of a workpiece is diffusion coated. Jet engine vanes are examples of workpieces generally coated in this manner. It is also not necessary that the individual retorts be tubes open at each end, and they can for instance be of one-piece construction with a floor integrally extending across the bottom of the retort. The individual retorts need not be hatch treated as in the arrangement illustrated in Fig. 3. Instead they can be treated in a generally continuous manner as by passing them in succession into a tube of a tubular furnace, -pushing them through the tube so that they are so heated to diffusion coating temperature for a time adequate to effect the desired coating, successively withdrawing the so-heated retorts from the furnace tube as fresh retorts are pushed in, and emptying the withdrawn retorts so that they can be repacked. The individual retorts can substantially fill the cross-section of the tube. The retorts can be pushed to cause them to slide along the floor of the tube and push each other in a row through the tube. A protective gas can be flushed through the tube to maintain a protective atmosphere in the diffusion coating zone, the gas having a density different from air, and the tube having loading and unloading openings at a level to which any air present tends to flow. The flushing gas can be hydrogen, with the pressure in the tube below atmospheric to minimize leakage of the hydrogen out of the tube. A continuous operation is illustrated in Fig. 4 which shows a tubular or muffle furnace 110, the muffle or firing section 112 of which surrounds the central portion of a work-receiving tube 114 having a rectangular crosssection. The floor 116 of tube 114 has at either end of the tube, openings 118, 120 large enough to permit introduction and removal of a work-holding retort, several of which are shown in the tube at 131, 132, 133, 134, 135, 136 and 138. Removable plug-like floor segments 140, 141 are shaped to be received in openings 118, respectively and effectively keep those openings closed when there is no loading or unloading of the furnace to be carried out. Floor segments 140, 141 are carried on separate lift rods 144, 145 connected for vertical reciprocation of pneumatic cylinders 148, 149 respectively. A pusher arm 151 fits through the end wall of tube 114 at one end of the tube and is also connected for pneumatic operation to push the retorts toward the right as shown by arrow 152, when they are introduced into the tube on floor segment 140. Down tubes 155, 156 surround the loading and unloading openings 118, and project below them so as to envelop the space immediately below those openings. One or more side windows 158, 159 can be provided in the down tubes 155, 156 to permit lateral introduction and removal of the retorts. Inlet 161 is shown as connected to an upper portion of tube 114 to effect cooling and in the illustrated construction of a protective gas into the tube, and an outlet for that gas is shown at 162 at a lower portion of the tube leading to a hum-off exit 163y. A pump 164 can be provided in outlet 162 to help exhaust and maintain a slightly subatmospheric pressure within tube 114. Additional inlets for protective gas are shown at 171, 172 as connected to the upper portions of the down tubes 155, 156. Water jackets can, if desired, be applied to tube 114 to effect cooling and in the illustrated construction a small water jacket 175 is located on the outside of the tube floor adjacent opening 118 and between it and the muffle unit 112. This helps to keep opening 119 sealed shut during use of the furnace, particularly where a gasket is fitted between the opening and the floor segment. Another and larger water jacket 177 can surround tube 14 just beyond the muffle unit to help cool the contents of the tube in that location. Water jacket 177 can be divided into two parts longitudinally spaced from each other along the length of the furnace tube 114, and another muffle (not shown) inserted between them to provide a thermal aging treatment zone. Furnace 110 can be used for diffusion coating operations that are conducted with a protective atmosphere around the retorts as in U.S. Pat. 3,449,159, and can also be used for diffusion coating operations such as described in U.S. Pat. 2,851,375 where no such protective atmosphere is needed around the retorts. For use with such protective atmosphere the furnace can be turned on, tube 114 flushed with protective gas like argon, nitrogen or neon, until substantially all the air has been displaced, following which the protective gas is switched to hydrogen. Up to this point loading and unloading segments 140, 141 can be kept closed to improve the flush effectiveness. Loading segment 1410 is then lowered and a previously loaded retort placed on that segment while it is in lowered position after which the floor segment is raised to the position illustrated, thus carrying the retort into the loading end of tube 114. Pusher arm 151 is then actuated to push the retort into the position shown at 131 in the figure. As shown, the retort can have a height at least about 90 percent that of the inside height of tube 114. This not only keeps the retort from tipping over but it also causes the retort to act as a heat shield, reducing the loss of heat from the muffle or firing zone that would otherwise radiate through tube 114 toward its loading end. Making the retort at least about 90 percent as wide as the inside width of tube 114 also helps in this respect. At position 131 the advancing side of the retort begins to be heated up so that the ultimate heating to operating temperature is expedited. Another retort can now be loaded into tube 114 by repeating the above loading steps. This time however the pushing action of pusher 151 moves the first retort into position 132 and the second retort into position 131. Retort 132 is then exposed to the maximum furnace heat and soon reaches the temperature desired for the diffusion coating. Retort 131 acts as a heat shield as explained above, and thus helps retort 132 to rapidly reach the desired temperature. If it is desired to also shield the right-hand end of the muffle or firing unit 112, the furnace tube can be preloaded with a retort at position 135, which retort can be empty or filled with nothing more than thermal insulating powder or if desired the same powder used as the pack in the diffusion coating. In fact the furnace can be filled by preloading with five such preloaded retorts so that the first work-containing retort then introduced into position 131 goes through a treatment cycle which all subsequently loaded retorts repeat exactly. When the furnace is full of retorts, as shown in the figure, and enough time has elapsed to call for the introduction of another retort, the retort at position 1318 is withdrawn by lowering floor segment 141 to carry that retort down adjacent unload window 159. That retort can then be removed through that window while a fresh retort is loaded into the load end of tube 114 and the pusher ram 151 actuated to advance all the retorts one station. The unloading and loading is then repeated at appropriate intervals. At burn-off exit 163, the emerging gases which are essentially hydrogen, can be conveniently burned, thus reducing explosion hazards and also providing an indication of hydrogen flow. When a floor segment such as a load segment 140 is lowered, the tube 114 is opened to the atmosphere in a down tube. The introduction of protective gases into the down tubes provides a protective plug of gas some of which is drawn into the tube 114 by operation of pump 164, until the floor segment is returned to its uppermost position. When hydrogen is used as the protective gas in tube 114 it is desirable that the protective gas in the down tubes be of the inert gas type such as helium or nitrogen. The introduction of some helium or nitrogen into the tube 114 to mix with the hydrogen in that tube has no untoward effect on the diffusion coating yet the helium or nitrogen can escape through window 158 for example, without creating any significant hazard. In the interest of economy the helium or nitrogen flow can be held to the minimum so that escape through window 158 is quite gradual. Also the presence of appreciable concentrations of nitrogen in those positions of the furnace which are above 7000 F. is not desired inasmuch as it tends to convert the pack metal to less reactive nitrides. In the apparatus illustrated in Fig. 4 three retorts are being simultaneously heated to diffusion coating temperature. Accordingly if the entire heat treatment is to extend for 1½ hours a fresh retort can be inserted every half hour and the line of retorts stepped along. As the heated retorts reach position 135 they begin to cool and water jacket 177 greatly speeds such cooling as does the passage of cold flushing gas. One such cooling station is generally sufficient to cause the workpiece to cool down from coating temperature at the rate of 15° F. or more per minute to about 10000 F. The retorts can then go through a second muffle heating zone to age them before they reach the cooling position 136, or they can go directly from 135 to 136 if the second muffle is not to be used. A single cooling position 136 will suffice to cool the workpieces from a thermal aging treatment down to about 450° F. or below, at which temperatures the retorts can be brought out into the ambient air if they are covered as with a loosely fitting cover. If desired a supplemental cooling station can be provided in tube 114 inasmuch as two successive water-jacketed stations bring the final workpiece cooldown temperature to about 300° F. or below. The relatively large dimension of the retorts with respect to the furnace tube as pointed out above, helps assure proper sliding of the retorts through the tube by the pusher arm. The retorts can also have substantial width in the direction of travel, that is a longitudinal width at least about half the retort height and preferably at least 100 percent of the retort height. Also the lower corners of the retort can be tapered as shown at 139, to help them slide over the joints between the floor 116 and segments 140, 141, as well as to help guide the retorts out through unloading opening 120 in the event of a little misalignment. The tapers 139 also help with the unloading of the contents of the retorts inasmuch as the inside edges and corners are the most difficult parts to clean out. The furnace can be arranged to simultaneously fire any number of retorts and by increasing the fired number the furnace loading frequency is correspondingly increased. A furnace that simultaneously subjects ten retorts to maximum firing temperature can have the retorts introduced into the furnace at 9-minute intervals. Intervals of this magnitude are adequate for simple handloading of the retorts even where each retort contains a multiplicity of workpieces. However the retorts can be automatically loaded by machine, as for example where several furnaces are to be operated simultaneously. The loading of a single workpiece in a retort is illustrated in FIGS. 5A through 5E. Fig. 5A. shows a retort 121 positioned under a loading hopper 81. The hopper contains powder used in packing the workpieces and the powder is discharged in a batch 101 into the retort 121. In order to control the amount of this batch the retort is carried on a pan 91 of a weighing scale 92 which can automatically terminate the flow of powder. Since powders of this type are sometimes non-fluent, their discharge from the hopper 81 can be effected by a wire-type agitator 94 rotated as by an electric motor 9,5. With such non-fluent materials the flow stops fairly promptly when the rotation of the agitator stops, and by connecting a motor energizing relay to appropriate electrode contacts on scale 92 the loading of a first layer of powder 101 is conveniently effected in an automatic way. Fig. 5B shows another loading station where a retort 122 carrying the first layer of powder 101 is subjected to the action of a compacting ram 82. This ram has a face 96 which engages and compacts the powder 101 and also has a recessed socket 97 in which is fitted a workpiece 98 such as a jet engine blade to be coated. These blades are very accurately dimensioned so that it is no problem to have the mouth 99 of the socket 97 shaped to tightly receive a portion of the workpiece such as the projecting buttress illustrated. A single outward stroke of ram 82 will in the illustrated apparatus press the lower end 100 of the workpiece 98 into powder 101 and also compact the powder against that lower end. Ram 82 can then be withdrawn and if the workpiece is not locked in by the powder pressed against its lower convolutions, a knockout pin 112 can be provided to help hold the workpiece embedded in the powder during the withdrawal of ram 82. Fig. 5C shows another loading station in which a retort 123 is under a loading hopper 83. Retort 123 already carries powder 101 and embedded workpiece 98, and at this station the retort is filled or substantially filled with an additional layer of powder 102. Powder 102 can be introduced in the same manner as powder 101 at station 5A, except that at station 5C there is no need to use the weight control to terminate the loading of the powder. Since it is important to cover the entire workpiece with powder 102, that powder is permitted to pour in in generous excess and can even overflow over the top edge of the retort without harm. There is enough tolerance in the amount of powder required that the powder can be controlled with sufficient accuracy by timing the discharge from hopper 83 or timing the operation of an agitator in that hopper. The next step in the filling of a retort is shown in FIG. 5D. Here retort 124 containing powder 101, workpiece 98 and powder 102, is subjected to the compacting

action of a ram 104. This compacts the powder mixture against the workpiece and completes the packing. A loosely fitting lid 106 can then be placed over the compacted top of powder 102. The sequence of loading steps in FIGS. 5A through 5E is readily automated, as by using the automatic advancing and alignment arrangement shown in U.S. Pat. 3,253,496 granted May 31, 1966. In fact the introduction of powders 101 and 102 can also be carried out by the arrangement shown in that patent, particularly where the powders are extremely non-fluent. As in Fig. 1, the loading arrangement illustrated in Fig. 5A and 5E can use powder 101 that has a masking effect, and a powder 102 that causes coating, so that a coating is only applied to the upper or airfoil portion of the workpiece. Where two different powders are used as in Fig. 5D, the filling of a retort can be effected in inverse manner, the coating powder being introduced into the retort first and the masking or non-coating powder second. The furnace of the present invention can have its loading and unloading openings in the upper wall of tube 114 instead of the floor, and this modification is helpful where a protective gas, such as argon which is heavier than air, is passed through the tube. Up-tubes are then substituted for down-tubes 155, 156 and leakage of argon from tube 114 need not be so carefully guarded against. To this end pump 164 can be omitted. In the up-tubes each retort can be carried by a clamp that opens and closes, and engages the sides of the retort or fits against the tapered lower wall 139. On the other hand, where no protective atmosphere is used, the furnace tube 114 can have loading and unloading passageways in its end walls so that retorts can be more conveniently slid in and out. Where hydrogen or other combustible gas is continuously passed through tube 114 or through the furnace retort used with the arrangement of Fig. 3, it can be burned at a burner in the muffle 112, so as to help fire the furnace. The muffle or furnace shell can be completely gas-fired, inasmuch as this is less expensive than electric resistance firing at present day costs. Induction heating can also be used and can be applied either to heat the furnace retort of Fig. 3 or the furnace tube 114 of Fig. 4, or can be applied directly to the individual workpiece retorts 10 or 124. Because of their rapid heat up and small size the retort packing arrangement of the present invention is particularly suited for use in the field where a special furnace is not available, yet a jet engine blade must be coated or recoated. The blade can be packed in a closely fitting retort sealed shut but fitted with a vent tube leading into a body of **liquid** that acts as a bubbler. The retort is then heated in any furnace such as found in a repair shop or even by a gasoline torch or the like, to bring its color temperature to the desired point, and held there for the prescribed time. The heating and decomposition of the activator ingredient in the pack causes gas to be evolved through the bubbler, and when bubbling stops the vent is sealed shut for the remainder of the treatment, until the heating is terminated and the retort cooled and ready for opening. Extra activator can be present in the coating pack for such field use so that gas evolution will continue during the entire heat treatment and sealing of the vent need not be effected until the heating is completed. Instead of moving retorts through a furnace tube 114 in steps as described in connection with Fig. 4, they can be moved through on a continuous basis at a slow speed. For this purpose it is desirable to have the retorts carried on a moving belt rather than pushed along the floor 116. The belt can be made of wire mesh and be in endless form mounted between two end rollers located at or just beyond the limits of the retort travel. Loading the retorts onto and removal from the belt is readily accomplished through up-tubes located at the ends of furnace tube 114 as described above, or outside the ends of tube 114, where no special atmosphere is maintained during the diffusion coating. The structural members in the hottest part of the furnace should be made of materials that satisfactorily withstand the high temperatures to which they are exposed. Thus furnace tube 114 as well as the retorts and a conveyor where such is used can be made of materials like Inconel or even thoria-dispersed nickel coated with chromium and aluminum as described in U.S. Pat. 3,556,744 for very high temperature use, and of high alloy stainless steels for temperatures below about 1800° F. It is not necessary for a workpiece to be entirely covered by powder pack. Thus only the surface portion required to be coated can be packed in the powder coating pack, and the remainder of the workpiece can be completely uncovered. The uncovered portions will then generally pick up a little coating, particularly when the coating is effected with relatively large amounts of energizer in the coating pack, and when the coating is carried out in a glass-sealed retort as in U.S. Pat. No. 2,851,375. Where such pick-up can be tolerated the packing can in this way be simplified. To this end the retort tube 13 can be omitted from the combination of Fig. 1 along with the masking powder 18, and the packed retort tube 11 positioned upside down on tray floor 41 with exposed root 22 projecting up out of that tube. The retort so oriented can also be loaded onto loading plate 140 of the furnace of Fig. 4 for passage therethrough. In the last-mentioned modification, it is helpful to equip the furnace tube with thermal curtains that hang from the top of the tube at both ends of the muffle and depend low enough to be engaged by the tops of the retort tubes 11 to reduce thermal losses. The energizers usually contained in diffusion coating packs are generally halogens or halogen compounds that decompose at fairly low temperatures to gaseous products that purge residual air present in the retort. This purging action begins when a retort is loaded into tube 114. Thus 40 substantial quantities of halogen-containing purging gases and some air are expelled by the retort in position 131. These are flushed out through outlet 162 by the flushing action. To permit this purging, the retort should not be hermetically sealed and in practice it is usual to provide it with a loosely-fitting cover although it can be left uncovered if desired. Should the energizer content of the pack diffuse away leaving essentially none behind, the coating action sharply diminishes. This characteristic can be used to limit the coating to a period less than that use for the solution heat treatment. However it is preferred to keep the coating thickness down by using less effective coating mixtures. Thus with coatings from an aluminum-chromium pack as described in Canadian Pat. 806,618, a prescribed solution heat treatment recipe can be arranged to produce less coating by increasing the proportion of chromium and/or decreasing the proportion of aluminum in the pack. It is a feature of the present invention that the workpieces are diffusion coated and solution heat treated simultaneously so that reheating to solution heat treating temperatures is not needed. Such reheating is not as effective for solution heat treatment as an original heating. That (5) is to say the strongest products are those that have been given only one heat treatment at solution heat treatment temperatures. It is another feature of the present invention that individual workpieces in different retorts can be simultaneously subjected to different types of coating treatments, either by the batch operation as in Fig. 3 or the continuous operation as in Fig. 4. To reduce the possibility of cross-contamination retort having different packs can be spaced from each other and in addition blank retorts can 7.5 be interposed between them. These blank retorts can contain coated metal powder to help keep contaminants from escaping from the separated retorts. For the batch type operation the longest coating time needed for the different simultaneous coatings is used as the heat treating time, and if any of the coatings requires less time, its pack can have an appropriately less effective pack. In the continuous type treatment this technique can also be used but in addition the times and/or treating temperatures can be changed by controlling the muffle firing and retort advancing action so as to coordinate with the particular retorts being advanced. Also the retorts in a continuously treated series for which different coating temperatures are to be applied, can be separated from each other by blank retorts so that two such different temperature retorts are not in the muffle zone at one time. The present invention can be practiced with the diffusion coating of aluminum, chromium, tantalum, silicon or any other metal or combinations of metals, and preferably on substrates that like nickel-base superalloys are desirably heat treated. Ordinary high-carbon steels and air **hardening** tool steels are other examples of such heat treatable metals although some of these steels are solution treated at about 14000 F. The following are typical coating-heat treating examples of the present invention: EXAMPLE I Coating pack: Percent by weight Chromium powder (325 mesh) -----60 Aluminum powder (325 mesh) -----20 Aluminum oxide powder (325 mesh) -----19.5 Ammonium chloride powder (325 mesh) -----0.5 This pack is heated to 1950 to 20000 F. for five hours in a retort under a flow of hydrogen to break it in. It is then unloaded from the retort, fresh ammonium chloride added, the mix put through a sieve, subsequently tumbled to insure a uniform mixture and used directly for processing. In the arrangement of Fig. 3 it will effect a very protective 0.0030" thick coating on IN-738 alloy heated in that powder for two (2) hours at 2050' F. This coating consists mainly of aluminum, chromium and nickel. EXAMPLE II Coating pack: Percent by weight Chromium powder -----20 Aluminum oxide powder -----79.5 Ammonium chloride powder -----0.5 The mix was broken in as in Example I at 1900' F. for five (5) hours. Then after makeup of the ammonium chloride, it was sifted, tumbled and used to produce at 2000' F. for four (4) hours a chromium diffused coating with a case of 0.00,12" on nickel base superalloys such as B-1900 (8 percent chromium, 10 percent cobalt, 1 percent **titanium**, 6 percent aluminum, 6 percent molybdenum, 0.11 percent carbon, 4.3 percent tantalum, 0.15 percent boron, 0.07 percent zirconium, and the balance nickel). EXAMPLE III The following mix and process will produce a tantalum diffused coating on nickel base superalloys such as Udimet 700 (15 percent chromium, 18.5 percent cobalt, 3.25 percent **titanium**, 4.25 percent aluminum, 5 percent molybdenum, 0.1 percent carbon, 0.03 percent boron, and the remainder nickel). Percent by weight Chromium powder -----3 Tantalum powder -----Nickel powder -----2.5 Aluminum oxide powder -----84 Ammonium chloride powder -----1/2 The mix was broken in as above at 1850' F. for eight (8) hours followed by makeup, sifting and tumbling prior to use. A case depth of about 0.001" was developed on the U-700 superalloy when processed at 2000' F. for twenty (20) hours.

Classifications:

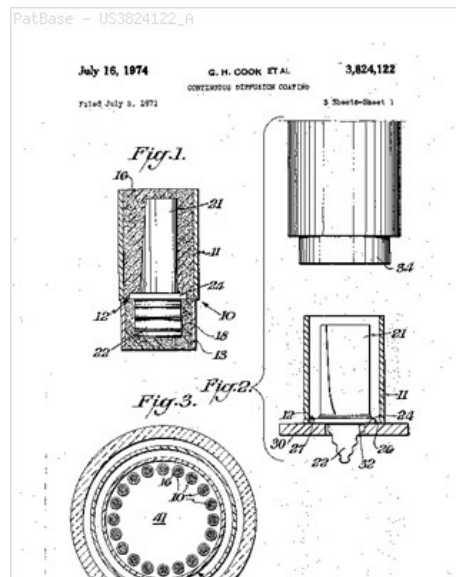
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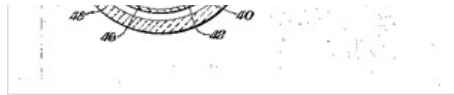
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CPC: C23C10/04 C23C10/34 C23C10/60

European: C23C10/04 C23C10/34 C23C10/60

US: 148/527 427/252 427/301 427/444





Family:

Publication number	Publication date	Application number	Application date
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FR2144716 A1	19730216	FR19720023873	19720630
FR2144716 B1	19741227	FR19720023873	19720630
US3824122 A	19740716	US19710159175	19710702
US3903338 A	19750902	US19730426326	19731219

Priority:

US19710159175 19710702 US19730426326 19731219

Probable Assignee: ALLOY SURFACES CO INC

Assignee(s): (std): ALLOY SURFACES CO INC ; BALDI A ; ONERA ; ONERA OFF NAT AEROSPATIALE ; COOK G

Assignee(s): COOK G US ; ALLOY SURFACES CO ; ONERA FR ; COOK GEORGE H ; BALDI A US ; BALDI ALFONSO L ; ALLOY SURFACES COMPANY INC

Inventor(s): (std): BALDI A ; BALDI ALFONSO L ; COOK G ; COOK GEORGE ; COOK GEORGE H

Inventor(s): COOK G US ; BALDI A US

Title: Improvements in or relating to the production of metallic coatings on the surfaces of metals

Abstract: Source: GB740104A Metal articles are provided with a continuous coating of another metal by embedding them in a mass of clean malleable non-laminar particles of plating metal and impacting the particles so as to flatten and bond them on to the surfaces of the articles in interfitting layers at a temperature below the melting point of the plating metal but high enough to permit the necessary distortion and flattening of the particles, the operation being carried out in a water-free gaseous or evacuated environment. The plating of small articles such as nails, nuts, bolts and other small hardware, preferably after cleaning by pickling or abrasive tumbling, may be carried out by tumbling them together with the plating particles, and optionally additional impacting material such as steel shot, in a tumbling mill, in which the air is dried by the action of the plating particles, or to which a non-oxidizing gas (e.g. from solid CO2) is supplied, or which is evacuated. The method is described as applicable to the coating of zinc, magnesium, aluminium, iron and steel articles with Al, Zn, Cd, Sn, Pb, Cu, Ag, Mg and Ni. The temperature is preferably chosen so that while the metal particles do not melt on impact, they reach the minimum recrystallization temperature. Specification 740,075 is referred to.

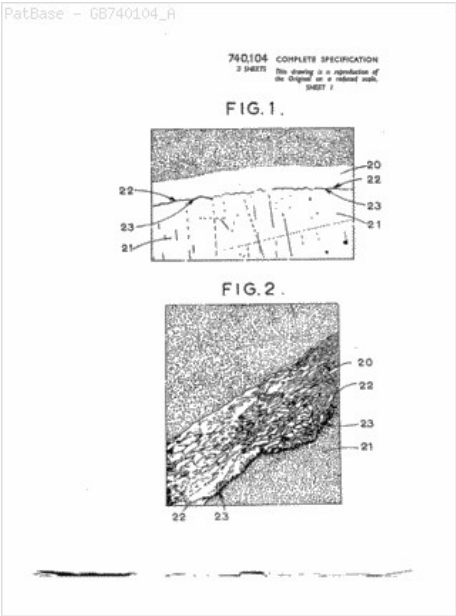
Classifications:

International (IPC 8-9): C23C24/04 (Advanced/Invention);
C23C24/00 (Core/Invention)

International (IPC 1-7): C23C17/00

CPC: C23C24/045

European: C23C24/04B



Family:

Publication number	Publication date	Application number	Application date
GB740104 A	19551109	GB19540010448	19510322

Priority:

GB19540010448 19510322

Probable Assignee: TANTON COMPANY

Assignee(s): (std): TANTON COMPANY

Assignee(s): THE TANTON COMPANY ; TANTON CO

Inventor(s): (std): CLAYTON ERITH TANTON ; POTTBERG ROLFE

Title: METHOD FOR SMOOTHING THE SURFACE OF A PROTECTIVE COATING

Abstract: Source: US6294261B A method for smoothing the surface of a ceramic-based protective coating which exhibits roughness is disclosed. The method includes the steps of applying a ceramic-based slurry or gel coating to the protective coating surface; heating the slurry/gel coating to remove volatile material; and then further heating the slurry/gel coating to cure the coating and bond it to the underlying protective coating. The slurry/gel coating is often based on yttria-stabilized zirconia, and precursors of an oxide matrix. Related articles of manufacture are also described.

Classifications:

International (IPC 8-9): C23C10/18 C23C24/10 C23C26/00 C23C28/00 C23C28/04 C23C4/10 C23C4/18 F01D5/28 F01D9/02 F02C7/00 F23R3/42 (Advanced/Invention); C23C4/18 (Advanced/Non-invention);

C23C10/00 C23C24/00 C23C26/00 C23C28/00 C23C28/04 C23C4/10 C23C4/18 F01D5/28 F01D9/02 F02C7/00 F23R3/00 (Core/Invention)

International (IPC 1-7): B32B9/00 C23C10/18 C23C24/10 C23C26/00 C23C28/00 C23C28/04 C23C4/10 C23C4/18 F01D5/28 F01D9/02 F02C7/00 F23R3/42

CPC: C23C28/3215 C23C28/324 C23C28/3455 C23C28/36 C23C26/00 C23C4/18 C23C10/18 C23C24/10 F05B2250/62 Y02T50/67

European: C23C10/18 C23C24/10 C23C26/00 C23C28/00 C23C4/18 R05B250/62 Y02T50/67

US: 416/241.00B 416/241.00R 416/241B 416/241R 428/469 428/472 428/472.2 428/702

PatBase - US6294261_BA

U.S. Patent

Sep. 25, 2001

US 6,294,261 B1

Figure 1

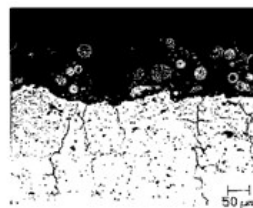
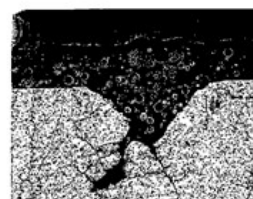


Figure 2



Family:

Publication number	Publication date	Application number	Application date
EP1088908 A2	20010404	EP20000308613	20000929
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KR20070104495 A	20071026	KR20070096233	20070921
US6294261 BA	20010925	US19990409878	19991001

Priority:

US19990409878 19991001

Probable Assignee: GENERAL ELECTRIC CO

Assignee(s): (std): GEN ELECTRIC

Assignee(s): GENERAL ELECTRIC CO ; GENERAL ELECTRIC COMPANY ; ENERGY UNITED STATES DEPARTMENT OF

Inventor(s): (std): JOHNSON CURTIS ALAN ; NELSON WARREN ARTHUR ; SANGEETA D ; SANGEETA D NMN

Designated states: AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU MC NL PT SE