Office de la Propriété Intellectuelle du Canada
Un organisme d'Industrie Canada

Canadian Intellectual Property Office
An agency of Industry Canada

CA 2475321 C 2008/07/22

(11)(21) 2 475 321

(12) BREVET CANADIEN
CANADIAN PATENT

(13) C

(86) Date de dépôt PCT/PCT Filing Date: 2002/11/27
(87) Date publication PCT/PCT Publication Date: 2003/08/14
(45) Date de délivrance/Issue Date: 2008/07/22
(85) Entrée phase nationale/National Entry: 2004/08/04
(86) N° demande PCT/PCT Application No.: US 2002/035062
(87) N° publication PCT/PCT Publication No.: 2003/066331
(30) Priorité/Priority: 2002/02/04 (USPCT/US02/02916)

(51) Cl.Int./Int.Cl. *B29C 70/50* (2006.01),
B29B 15/12 (2006.01)

(72) Inventeur/Inventor:
PAYNE, LEROY, US

(73) Propriétaire/Owner:
PAYNE, LEROY, US

(74) Agent: GOWLING LAFLEUR HENDERSON LLP

(54) Titre : PROCEDE ET APPAREIL DE FORMATION D'UNE STRUCTURE
(54) Title: STRUCTURE FORMING METHOD AND APPARATUS

(57) Abrégé/Abstract:
A method of forming a composite structure includes preselecting two liquid inter-reactive resin forming materials and determining the relative quantities for substantially complete inter-reaction thereof. The resin forming materials are flowed by gravity along a tortuous common path to effect thorough mixing thereof. The resulting mixture by gravity is delivered downwardly onto a porous blanket moving along a downwardly inclined path closely adjacent to a rotating cylindrical surface. The blanket is passed through a pool of the mixture. and between closely adjacent driven roller surfaces. The mixture-treated blanket is placed into contact with a preselected final surface while migrating part of the resin forming mixture through the blanket substantially uniformly to form a continuous resin matrix within the blanket. A tight permanent bond is formed between the matrix/blanket and the final surface. Also, apparatus for forming the composite structure.

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
14 August 2003 (14.08.2003)

PCT

(10) International Publication Number
WO 03/066331 A1

(51) International Patent Classification[7]: B32B 31/00, E01C 23/03, E02B 3/12

(21) International Application Number: PCT/US02/35062

(22) International Filing Date:
27 November 2002 (27.11.2002)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
PCT/US02/02916 4 February 2002 (04.02.2002) US

(63) Related by continuation (CON) or continuation-in-part (CIP) to earlier application:
US PCT/US02/02916 (CIP)
Filed on 4 February 2002 (04.02.2002)

(71) Applicant and
(72) Inventor: **PAYNE, Leroy** [US/US]; 4336 christensen Road, Billings, MT 59101 (US).

(74) Agent: **URBAN, Arthur, L.**; HC 50 Box 4045, Red Lodge, MT 59068-9708 (US).

(81) Designated States *(national)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CR, CU, CZ, DE, DK, DM, DZ, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZM, ZW.

(84) Designated States *(regional)*: ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:
— *with international search report*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

WO 03/066331 A1

(54) Title: STRUCTURE FORMING METHOD AND APPARATUS

(57) Abstract: A method of forming a composite structure includes preselecting two liquid inter-reactive resin forming materials and determining the relative quantities for substantially complete inter-reaction thereof. The resin forming materials are flowed by gravity along a tortuous common path to effect thorough mixing thereof. The resulting mixture by gravity is delivered downwardly onto a porous blanket moving along a downwardly inclined path closely adjacent to a rotating cylindrical surface. The blanket is passed through a pool of the mixture. and between closely adjacent driven roller surfaces. The mixture-treated blanket is placed into contact with a preselected final surface while migrating part of the resin forming mixture through the blanket substantially uniformly to form a continuous resin matrix within the blanket. A tight permanent bond is formed between the matrix/blanket and the final surface. Also, apparatus for forming the composite structure.

WO 03/066331 PCT/US02/35062

STRUCTURE FORMING METHOD AND APPARATUS

This invention relates to a novel composite structure forming method and apparatus. The present invention provides a novel method and apparatus which overcome the shortcomings of previous expedients. In addition, the method and apparatus provide features and advantages not found in earlier technology. The method and apparatus of the invention can be modified to form a variety of structures of high quality.

A novel method of the present invention for forming a composite structure includes the steps of preselecting two liquid inter-reactive resin forming materials and a porous blanket. The relative quantities of the resin forming materials are determined for substantially complete inter-reaction therebetween. The resin forming materials are placed closely adjacent to one another.

The resin forming materials flow by gravity into a chamber and along a tortuous common path through the chamber to effect thorough mixing thereof. The resulting mixture is delivered by gravity downwardly onto the porous blanket moving along a downwardly inclined path closely adjacent to a rotating cylindrical surface closely adjacent to the porous blanket. A pool of the mixture is formed on the blanket.

The blanket passes through the pool as it is moving along a downwardly inclined path and then between closely adjacent driven roller surfaces. Part of the resin forming mixture is migrated through the blanket substantially uniformly to form a continuous resin matrix within the blanket.

A tight permanent bond is formed between the matrix/blanket and the final surface. Advantageously, pressure is applied to the treated blanket to form the permanent bond.

The mixture-treated blanket may be cut into predetermined lengths and a plurality of the treated blanket lengths arranged successively in a preselected overlapping relationship to form a continuous structural assembly of considerable length.

Benefits and advantages of the novel method and apparatus of the present invention will be apparent from the following description.

One form of novel composite structure forming apparatus of the present invention includes a supporting portion, a material supplying portion, a mixing portion, a matrix forming portion, a positioning portion and a control portion.

The supporting portion of the composite structure forming apparatus of the invention includes a plurality of spaced upstanding frame members. A plurality of frame members join the frame members to provide a frame assembly. The supporting portion includes carriage means extending downwardly from the frame assembly.

Advantageously, the supporting portion includes accessories such as a handle crank cleaning blades and the like. The accessories can be mounted on and/or suspended from the frame assembly.

The material supplying portion of the apparatus includes a plurality of reservoirs operatively connected with the supporting portion. The reservoirs which advantageously are located on the frame assembly are operatively associated with the supporting portion. The reservoirs are connected independently with mixing portion through conduits with quick connect fittings.

The mixing portion includes an elongated mixing chamber with internal baffle sections. The mixing chamber is mounted on frame assembly.

The matrix forming portion of the apparatus includes mixture distributing means adjacent an outlet of the mixing chamber. The mixture distributing means as shown in the drawings includes an elongated plate member disposed in a dowwardly extending inclined orientation. A horizontlly disposed rotatable drum member is closely spaced adjustably to the inclined plate member and closely adjacent to the mixing chamber outlet. At least one cleaning blade extends outwardly from the drum member.

The positioning portion of the structure forming apparatus of the invention includes pressure applying means shown as cooperating rollers disposed closely adjacent to a lower edge of plate member. The rollers are operatively connected selectively to the carriage means through a belt or clutch.

The structure forming apparatus advantagously includes removable outer panels selectively hung from the apparatus to enclose the apparatus during storage. Also, the panels help to

control wind, temperature, other weather conditions, etc. during operation.

In the formation of a composite structure with the apparatus of the invention the structure forming apparatus is transferred to a job site and wheeled into position adjacent to a previously selected starting position.

Operation of the structure forming apparatus is begun by preselecting two liquid reactive resin forming materials and a porous blanket. Predetermined quantities of the resin forming materials in separate reservoirs are positioned on frame assembly and operatively connected to mixing chamber.

The predetermined quantities of the resin formers are gravity fed through the baffle section of mixing chamber. The mixture delivered from outlet of the mixing chamber passes downwardly onto porous blanket advancing along inclined plate member moving. The mixture is delivered at a rate sufficient to form a residual pool between the plate member and drum member closely thereto.

As the blanket exits the liquid pool, the blanket passes between pressure rollers. Part of the resin forming mixture migrates through the blanket substantially uniformly to form a continuous resin matrix within the blanket. A tight permanent bond between the matrix/blanket and the final surface is created.

To produce high quality continuous composite structures of the invention, it is important that all of the steps of the method be carefully coordinated by control portion. The control portion of the structure forming apparatus of the invention includes programmable memory means and actuating means responsive thereto in combination with coordinating means to control the operation of the various components of apparatus. Preferably, the coordinating means includes a process controller that initiates changes in the flows of materials and speeds of drives to bring variations therein back to the rates specified in the programs present in the memory. Advantageously, the control portion may control the lateral position of the blanket with respect to a preselected path.

This coordination commonly is achieved through the transmission of information such as digital pulses from monitors

and/or sensors at the control components to the process controller.

The operating information is compared with the preselected programming parameters stored in the memory. If differences are detected, instructions from the controller change the operation of the components to restore the various operations to the preselected processing specifications.

The reactive resin forming materials employed to produce composite structures of the invention are selected to be capable of inter-reaction to form the particular resin matrix or coating desired in the final structure. Advantageously, the material forms a thermosetting resin such as a polyurethane or polyester.

Should a polyurethane be desired, one reservoir may contain an isocyanate and another reservoir may contain a polyol. More commonly, the reservoirs may contain different partially formed materials which upon mixing interact to form the desired polyurethane. Examples of such partially formed materials include so-called "A stage" resins and "B stage" resins.

Additional components can be premixed with one of the resin formers, e.g. fillers, reinforcements, colors and the like.

A particulate solid additive material may be mixed with the liquid reactive resin forming material, preferably, in a proportion significantly greater than that of the resin forming material. The additive particles may be any of a wide variety of inexpensive materials readily available at a particular job site. Natural mineral particulate materials such as sand and gravel normally are available or can be produced simply by crushing rock at the site.

Also, materials such as waste or recycled materials which can be shredded or ground into particles of suitable size can be utilized. Especially useful are particles formed by shredding or grinding discarded tires. Since the particles are encapsulated with resin forming material and not saturated therewith, many different waste materials may be employed.

Suitable porous blankets include woven, knit, non-woven structures, etc. The blankets e.g. fabrics, mats, etc. may be formed of continuous or discontinuous fibers, yarns, slit ribbons and similar natural and synthetic fibrous materials. Reinforcing members such as ropes, cables, etc. extending longitudinally

and/or transversely of the blanket centerline may be included if desired.

The above description show that the present invention provides a novel method and apparatus which overcome the shortcomings of previous expedients and in addition, provide features and advantages not found in earlier technology. The method and apparatus can be modified to form a variety of different structures of high quality.

It will be apparent that various modifications can be made in the particular method and apparatus described in detail above within the scope of the present invention. Components and procedures employed can be changed to meet specific process and structural requirements.

These and other changes can be made in the method and apparatus of the invention provided the functioning and operation thereof are not adversely affected. Therefore, the scope of the present invention is to be limited only by the following claims.

.CLAIMS

1. A method of forming a composite structure including the steps of preselecting two liquid inter-reactive resin forming materials and a porous blanket, determining the relative quantities of said resin forming materials for substantially complete inter-reaction thereof, placing said resin forming materials closely adjacent, flowing said resin forming materials by gravity into a chamber and along a tortuous common path therethrough to effect thorough mixing thereof, delivering the resulting mixture by gravity downwardly onto said porous blanket moving along a downwardly inclined path closely adjacent to a rotating cylindrical surface closely adjacent to said porous blanket, forming a pool of said mixture, passing said blanket through said pool and between closely adjacent driven roller surfaces, advancing said mixture-treated blanket into contact with a preselected final surface while migrating part of said resin forming mixture through said blanket substantially uniformly to form a continuous resin matrix within said blanket and forming a tight permanent bond between said matrix/blanket and said final surface.

2. A method of forming a composite structure according to Claim 1 wherein said liquid resin forming materials include partially formed resin materials.

3. A method of forming a composite structure according to Claim 1 wherein said liquid resin forming materials react to form a thermosetting resin.

4. A method of forming a composite structurre according to Claim 1 including the step of applying pressure to said treated blanket while it is in contact with said final surface to form a tight permanent bond therebetween.

5. A method of forming a composite structure according to Claim 1 including the step of cutting said mixture-treated blanket into a predetermined length as it is advanced into contact with said final surface.

6. Structure forming apparatus including a supporting portion, a material supplying portion, a mixing portion, a matrix forming portion, a positioning portion and a control portion; said supporting portion including a frame assembly including a plurality of spaced upstanding frame members and a plurality of generally horizontally disposed frame members joining said upstanding frame members, said supporting portion including carriage means extending downwardly from said frame assembly; said material supplying portion including a blanket supply roll and a plurality of reservoirs operatively associated with said supporting portion, said reservoirs being connected independently with said mixing portion through quick connect fittings, said mixing portion including an elongated mixing chamber with internal baffle sections, said mixing chamber being mounted on said frame assembly; said matrix forming portion including mixture distributing means extending downwardly from said mixing chamber and being disposed adjacent an outlet thereof, said mixture distributing means including an elongated plate member disposed in a downwardly extending inclined orientaion, a horizontally disposed rotatable drum member closely spaced adjustably to said inclined plate member and closely adjacent to said mixing chamber outlet, a cleaning blade extending upwardly from said drum member; said positioning portion including pressure applying rollers disposed closely adjacent to a lower edge of said plate member, and said rollers being operatively connected selectively to said carriage means to draw a porous blanket over said plate member and under said spaced rotatable drum member while saturating said blanket with a liquid mixture being delivered from said mixing chamber onto said moving blanket.

7. Structure forming apparatus according to Claim 6 wherein said mixture distributing means includes a second blade closely adjacent to said drum member remote from said first blade.

8. Structure forming apparatus according to Claim 6 wherein said pressure applying rollers include a pair of cooperating elongated rollers.

9. Structure forming apparatus according to Claim 6 wherein said supporting portion includes a crank associated with said pressure applying rollers.

10. Structure forming apparatus according to Claim 6 wherein said supporting portion includes a handle to facilitate maneuvering of said apparatus.