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(54) **Method of manufacturing a spent fuel cask**

(57) A period of time taken in manufacture of a cask for transportation and storage of spent fuel is shortened, and a radiation shielding capacity of a spent fuel cask is made uniform in an axial direction thereof.

A kneaded substance comprising a resin and a powder neutron absorber is injected into a horizontal mold. Subsequently, an operation of curing is performed. The resulting neutron shield body is taken out from the mold and is mounted between fins which are provided on an outside of an inner cylinder of a spent fuel cask. An outer cylinder is mounted on the fins to cover the neutron shield body.

FIG. 1

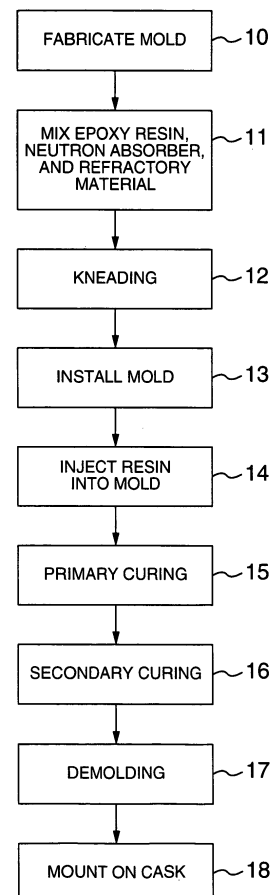
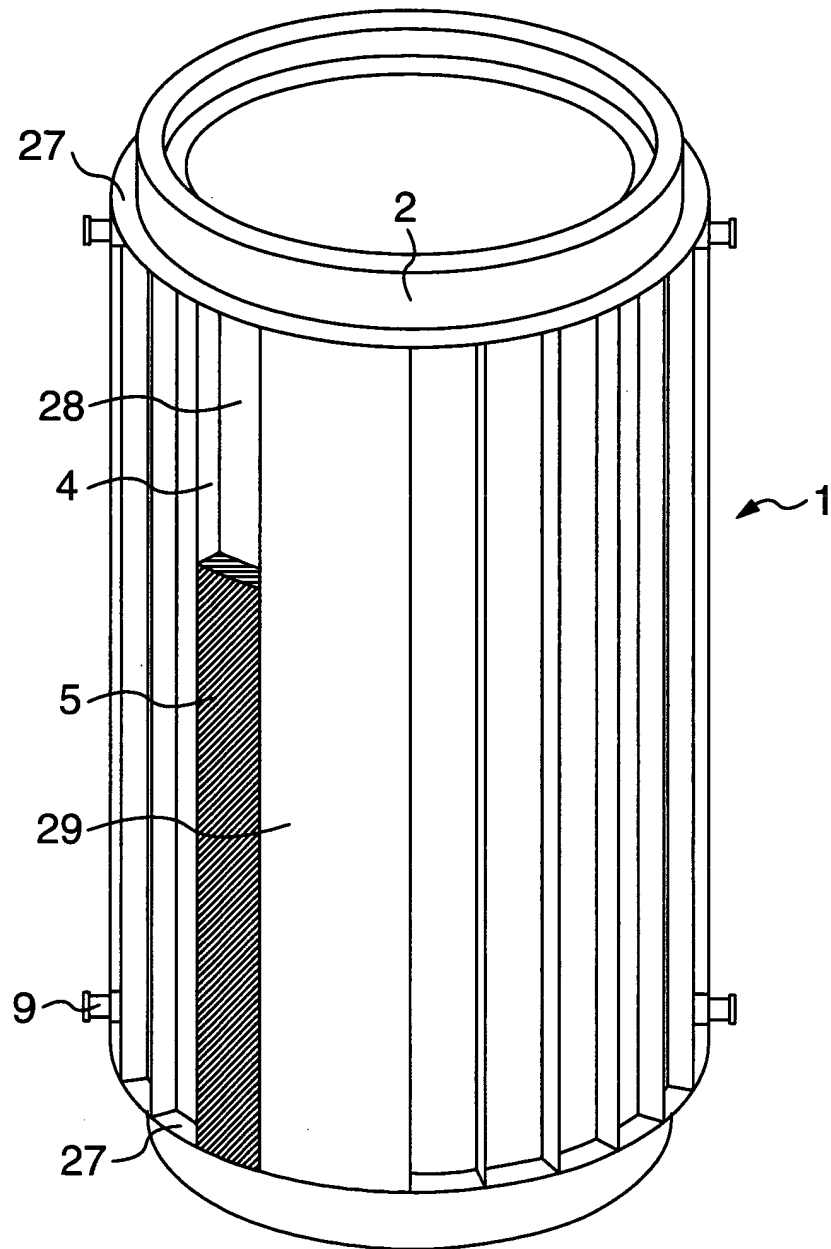


FIG. 6



Description

BACKGROUND OF THE INVENTION

[0001] The present invention relates to a spent fuel cask and a method of manufacturing the same, and more particular, to a cask for storage of a spent fuel suitable for transportation and storage of a spent fuel assembly and a method of manufacturing the same.

[0002] A spent fuel assembly having been used in a core of a nuclear reactor for a predetermined period of time is taken out from the core to be temporarily stored for a predetermined cooling period of time for the purpose of cooling in a spent fuel pool. A spent fuel assembly, for which the predetermined cooling period of time has elapsed, is received in a spent fuel cask (for example, a metallic cask) and transported to a fuel reprocessing facility or an intermediate storage facility. The spent fuel cask is provided with a radiation shield body, which shields radiation, such as neutron or the like, emitted from the received spent fuel assembly.

[0003] A spent fuel cask comprises an outer cylinder provided outside an inner cylinder, which constitutes a container, heat transfer fins made of carbon steel or the like and mounted on an outer surface of the inner cylinder to be spaced circumferentially at intervals, and a metallic basket formed inside the inner cylinder. A cured resin being a neutron shield body is present between the outer cylinder and the inner cylinder. The inner cylinder is a top-opened cylinder made of carbon steel and serves as a gamma-rays shield body. The metallic basket comprises a plurality of cells, in each of which a spent fuel assembly is received. The metallic basket receives therein about 30 to 70 spent fuel assemblies in total. Mounted in an opening of the inner cylinder is a primary lid for preventing leakage of a radioactive substance, and mounted outside the lid is a secondary lid. The cask has a height of about 4.5 m and a diameter of about 2.5 m, and a total weight of the cask in a state, in which spent fuel assemblies are received therein, amounts to around 100 to 150 tons. Used as a neutron shield body is a room temperature setting type epoxy resin, which ordinarily cures at room temperature, or a resin composed of silicone rubber, to which an admixture such as a powder neutron absorber and a powder refractory material is added.

[0004] The neutron shield body must assure a necessary neutron shielding capacity, and is mainly manufactured in the following manner. An admixture such as a neutron absorber such as powder boron carbide or the like, and a refractory material such as powder aluminum hydroxide or the like are mixed in an epoxy resin or silicone rubber, which make a base material, and these materials are adequately kneaded by a mixer to be made uniform. Such kneading is performed in a reduced pressure tank in order to prevent an decrease in shield capacity, caused by entrainment of an air.

[0005] As described in JP-A-2001-21684 and JP-A-

2001-83281, a neutron shield body having been sufficiently kneaded is injected into a space between an inner cylinder and an outer cylinder from above in a state, in which a spent fuel cask is made upright, to cure. In the case where an admixture such as a powder neutron absorber and a powder refractory material settles until a resin cures, and the admixture in an upper portion of the space is decreased in concentration, the neutron shielding capacity cannot be assured, so that there is a need of controlling viscosity of the resin, particles of the admixture, curing temperature, curing time, or the like so as to eliminate settling of the admixture. Also, JP-A-11-295483 describes injecting a resin into an upright square pipe from above and curing the same.

[0006] Since a period of time, during which an operation of injecting a resin having been increased in viscosity is enabled, is around 2 to 3 hours, it is necessary to carry out kneading of the resin and injection of the same into a cask within such period of time. Injection of neutron shield bodies into a space between an inner cylinder and an outer cylinder is carried out in installments since the space is large in volume. In order to prevent entrainment of an air, injection of neutron shield bodies is carried out while a portion, in which injection is performed, is reduced in pressure.

[0007] Settling of an admixture can be prevented by the use of a resin having a large viscosity. Since the use of a resin having a large viscosity leads to worsening of working efficiency at the time of injection and an increase in the number of control processes, it takes around a month to inject a resin into a single spent fuel cask and cure the same to finish a neutron shield body.

BRIEF SUMMARY OF THE INVENTION

[0008] It is an object of the invention to provide a spent fuel cask, a period of time taken in manufacture of which can be shortened and of which radiation shielding capacity can be made further uniform in an axial direction of the spent fuel cask, and a method of manufacturing the same.

[0009] The invention for attaining the object has a feature in injecting a resin and a neutron absorber into a horizontal mold to cure the resin to manufacture a neutron shield body, arranging the neutron shield body having been taken out from the mold, outside an inner cylinder, to which a plurality of fins are mounted, and between the fins, and mounting an outer cylinder on the fins to cover the neutron shield body.

[0010] Also, the invention for attaining the object has a feature in a spent fuel cask provided with neutron shield bodies, comprising an inner cylinder, in which a spent fuel is received, a plurality of fins provided in the inner cylinder, neutron shield bodies arranged between adjacent fins, and an outer cylinder to cover the neutron shield bodies.

[0011] Since a neutron shield body is manufactured by injecting a resin and a neutron absorber into the mold

and arranged outside the inner cylinder, a period of time taken in manufacture of the neutron shield body is considerably shortened. Also, a resin and a neutron absorber are injected into a mold, which is laid horizontal, the neutron absorber is rich in the vicinity of a bottom of the mold and distributed uniformly in a lengthwise direction of the mold. Therefore, with the spent fuel cask provided with neutron shield bodies mounted thereon, the neutron absorber is present to be rich radially toward the inner cylinder, and distributed uniformly in an axial direction of the cask. Therefore, the radiation shielding capacity of the spent fuel cask is made further uniform in the axial direction of the spent fuel cask.

[0012] Other objects, features and advantages of the invention will become apparent from the following description of the embodiments of the invention taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013]

Fig. 1 is a view illustrating manufacturing processes in a method of manufacturing a spent fuel cask, according to a preferred embodiment of the invention; Fig. 2 is a perspective view including a partial cross section of a spent fuel cask manufactured by the manufacturing method of Fig. 1;

Fig. 3 is a perspective view showing a mold used in the manufacturing processes of Fig. 1;

Fig. 4 is a view illustrating a state, in which a kneaded substance is injected in STEP 14 in Fig. 1;

Fig. 5 is a view illustrating a state, in which an admixture settles in the mold, in STEP 15 in Fig. 1;

Fig. 6 is a view illustrating a state, in which neutron shield bodies manufactured in the processes in Fig. 1 are mounted on an inner cylinder; and

Fig. 7 shows a state, in which neutron shield bodies obtained in the manufacturing method of Fig. 1 are arranged on a spent fuel cask, Fig. 7(A) being a longitudinal, cross sectional view showing the spent fuel cask with the neutron shield bodies mounted thereon, and Fig. 7(B) being a cross sectional view taken along the line Y - Y in Fig. 7(A).

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0014] A method of manufacturing a spent fuel cask according to a preferred embodiment of the invention will be described below. First, an outline structure of a spent fuel cask manufactured according to the embodiment will be described with reference to Fig. 2. The spent fuel cask 1 comprises an inner cylinder 2 provided in an outer cylinder 3, which constitutes a container, heat transfer fins 4 made of carbon steel and mounted on an outer surface of the inner cylinder (inside container) 2 to be spaced circumferentially at intervals, and a metallic basket 6 formed inside the inner cylinder 2 in a lattice-like manner. Neutron shield bodies 5 are arranged in respective spaces defined by the heat transfer fins 4 between the outer cylinder 3 and the inner cylinder 2. The inner cylinder 2 is a top-opened cylinder made of carbon steel to serve as gamma-rays shield body. The metallic basket 6 comprises a plurality of cells, in each of which a spent fuel assembly is received. Mounted in an opening of the inner cylinder 2 is a primary lid 7 for preventing leakage of a radioactive substance, and mounted outside the lid is a secondary lid 8. A neutron shield body 5 is also arranged in the primary lid 7. Mounted on a side of the outer cylinder are a plurality of trunnions 9, which are used for suspension of the spent fuel cask 1.

[0015] As shown in Fig. 1, a method of manufacturing a spent fuel cask will be described, in which operations are carried out in STEP 10 to STEP 18. First, a mold 20 (Fig. 3), into which a resin being a material for the neutron shield body 5 is injected, is fabricated (STEP 10). The mold 20 is constituted by mounting two long side plates 23 and two short side plates 24 to a bottom plate 22, and a portion of the mold facing the bottom plate 22 is opened. The side plates 23 and the side plates 24 are joined together. A resin injection portion 21 is formed inside the mold 20. The mold 20 comprises a resin injection space 21 inside. The side plates 24 have the same shape as a cross sectional shape of a space (a space prior to mounting of the neutron shield body 5), which is surrounded and defined by the inner cylinder 2, the outer cylinder 3, and two opposed heat transfer fins 4, in a direction perpendicular to an axis of the spent fuel cask 1. Therefore, a longitudinal, cross sectional shape of the neutron shield body 5, which is manufactured by injecting a kneaded substance containing a resin into the resin injection space 21, is the same as a cross sectional shape of the space in the direction perpendicular to the axis of the spent fuel cask 1. A distance between the opposed side plates 24 corresponds to a length of one of a plurality of sections, into which the space mounting therein the neutron shield body 5 is divided in an axial direction of the spent fuel cask 1, in view of operability at the time of manufacture of the neutron shield body 5 and at the time of handling of the body. The bottom plate 22 defines a configuration of the neutron shield body 5 toward the inner cylinder 2. A surface of the neutron shield body 5 on an opened side of the mold 20 will face the outer cylinder 3. Therefore, the mold 20 is shaped to diverge upward from the bottom plate 22, so that the neutron shield body 5 having been cured and formed in the mold 20 is made easy to take out.

[0016] A resin (epoxy resin), a powder neutron absorber, and a powder refractory material are mixed (STEP 11). In the embodiment, an epoxy resin used for manufacture of the neutron shield body 5 is a thermosetting-type one having the thermal resistance and curing at a higher temperature than room temperature upon application of heat from outside. As a concrete thermo-

setting-type epoxy resin, at least one of glycidyl ether type epoxy compounds such as bisphenol A type, novolak type, or alicyclic ones, various glycidyl ester type epoxy compounds, glycidyl amine type epoxy compounds, and biphenyl type epoxy compounds, is used to serve a principal ingredient, and also at least one of amine hardening agents, such as aromatic amine, alicyclic amine, polyamide amine, or the like, acid anhydride hardening agents, and imidazole hardening accelerating agents, is used as a hardening agent having the function of performing ring-opening polymerization of an epoxy radical of the principal ingredient. One of the principal ingredients and the hardening agent are mixed to be used.

[0017] Concretely, used as a powder neutron absorber is one of boron compounds such as boron carbide, boron nitride, or the like, cadmium compounds such as cadmium oxide, or the like, gadolinium compounds such as gadolinium oxide, or the like, and samarium compounds such as samarium oxide, or the like. Also, concretely, used as a powder refractory material is one of metalhydroxides such as magnesium hydroxide, aluminum hydroxide, calcium hydroxide, or the like, metallic oxide hydrates, inorganic phosphoric acid compounds such as ammonium polyphosphate, or the like, organic phosphorus compounds such as phosphate ester, or the like, and halogen compounds such as hexabromobenzene, tetrabromobisphenol A, or the like. Addition of the refractory material eliminates an increase in thickness of the neutron shield body 5 and makes it possible to prevent a decrease in density of hydrogen number. Further, addition of the refractory material makes the neutron shield body 5 hard to burn.

[0018] Kneading (STEP 12) is adequately carried out at reduced pressure so that the materials are uniformly mixed together by means of a mixer and an air is excluded from the kneaded substance. The mold 20 is installed in a location, in which the kneaded substance obtained in STEP 12 is to be injected (STEP 13). At this time, the mold is maintained in a horizontal position with the bottom plate 22 facing downward. A mold release agent is applied on inner surfaces of the mold 20. Thereafter, the kneaded substance 25 is injected into the mold 20 (STEP 14). Injection of the kneaded substance 25 into the mold 20 is performed by means of a length of hose (or trough) 30 (see Fig. 4). Since the bottom plate 22 of the mold 20 is opened upward, bubbles entrained into the kneaded substance at the time of injection thereof are liable to go out. After the completion of injection of the kneaded substance, an operation for primary curing is carried out (STEP 15). The primary curing is performed by placing the mold 20, into which the kneaded substance has been injected, in a heating furnace while keeping the mold in a horizontal position, and heating the kneaded substance in the mold 20. Instead of placing the mold in the heating furnace, the mold 20 may be heated by means of a heater. At the time of primary curing, the resin contained in the kneaded substance 25 in

the mold 20 is temporarily decreased in viscosity, so that an admixture (neutron absorber and refractory material) 26 contained in the kneaded substance settles near the bottom plate 22 of the mold 20 (see Fig. 6). The admixture 26 having settled settles on the bottom of the mold 20 substantially uniformly. After the termination of primary curing, a secondary curing is performed (STEP 16). In order to further increase the resin in polymerization degree, the secondary curing is performed to heat the kneaded substance in the mold 20 at a higher temperature than the heating temperature in the primary curing. The neutron shield body 5 being a cured substance, which the kneaded substance has completely cured to generate, is taken out from the mold 20 (STEP 17). The process in STEP 17 is called demolding. Since the mold release agent is applied on the inner surfaces of the mold 20, the neutron shield body 5 does not adhere to the inner surfaces of the mold 20 and can be readily taken out from the mold 20. The neutron shield body 5 having been taken out from the mold 20 is mounted outside the inner cylinder 2 of the spent fuel cask 1 (STEP 18).

[0019] An operation of mounting the neutron shield bodies 5 on the spent fuel cask 1 will be described in detail with reference to Fig. 6. The spent fuel cask 1 with the outer cylinder 3 not mounted thereon is laid horizontally on a rotating roller of a support member (not shown) having the rotating roller. That is, both ends of the inner cylinder 2 are supported by the rotating roller. With the spent fuel cask 1, a pair of shield covers 27 and the heat transfer fins 4 are mounted on outer surfaces of the inner cylinder 2. One of the shield covers 27 is mounted on an upper end of the inner cylinder 2, and the other of the shield covers 27 is mounted on a lower end of the inner cylinder 2. The plurality of heat transfer fins 4 are arranged between the pair of shield covers 27 and at predetermined spacings circumferentially of the inner cylinder 2. The neutron shield bodies 5 are successively arranged in respective spaces 28, each of which is defined by two adjacent heat transfer fins 4 and the pair of shield covers 27. The neutron shield bodies 5 are first arranged in several spaces 28, which face upward. An outer cylinder member 29 is arranged in a manner to cover the neutron shield bodies 5 arranged in the spaces 28, and peripheral portions of the outer cylinder member 29 are welded to the two heat transfer fins 4 and the pair of shield covers 27. The spent fuel cask 1 is rotated once to move the outer cylinder member 29 in a downward direction. The neutron shield bodies 5 are arranged in several spaces 28 extending from that space 28, which is disposed adjacent the spaces 28 covered by the outer cylinder member 29 to face upward. After the arranging operation is terminated, other outer cylinder members 29 are welded, as described above, to the heat transfer fins 4 and the shield covers 27 in a manner to cover the neutron shield bodies 5. By repeating such operation, the neutron shield bodies 5 are arranged in all the spaces 28 defined around the inner cylinder 2,

and the plurality of outer cylinder members 29 are mounted all around the spent fuel cask 1. An operation of mounting the neutron shield bodies 5 around the inner cylinder 2 is completed (see Fig. 7). The outer cylinder members 29 are mounted to hold the neutron shield bodies 5 between the inner cylinder 2 and the outer cylinder 3. A layer of the admixture 26 having settled during the operation of primary curing in STEP 15 is present on a side of the inner cylinder 2 in a state, in which the neutron shield bodies 5 are mounted. The neutron absorber constituting the admixture 26 is also present uniformly on the side of the inner cylinder 2 in an axial direction of the inner cylinder 2. Therefore, that macroscopic neutron absorption cross sectional area radially of the spent fuel cask 1, which determines the neutron shielding performance, is made substantially uniform in the axial direction of the inner cylinder 2.

[0020] The neutron shield body 5 mounted in the primary lid 7 is also manufactured in the procedure shown in Fig. 1. Since the neutron shield body 5 mounted in the primary lid 7 is in the form of a circular disk, however, a mold used comprises an annular side plate mounted on a circular bottom plate. The neutron shield body 5 mounted in the primary lid 7 is manufactured in the processes of STEP 11 to STEP 17 with the use of the mold. The finished neutron shield body 5 is received in a space defined in the primary lid 7. Thereafter, a circular disk is mounted on the primary lid 7 in a manner to cover the neutron shield body 5. A neutron shield body 5 (see Fig. 7(A)) mounted on the bottom of the spent fuel cask 1 is also manufactured in the same manner as the neutron shield body 5 mounted in the primary lid 7.

[0021] The spent fuel cask is completed in the processes of operation described above. By beforehand manufacturing and storing a necessary number of molds instead of manufacturing a mold 20 whenever a neutron shield body 5 is to be manufactured, there is no need of manufacturing a mold 20 whenever a neutron shield body 5 is to be manufactured. In this case, the manufacturing process of the spent fuel cask shown in Fig. 1 may comprise respective operations in STEP 11 and the following STEPs.

[0022] According to the embodiment, since a resin is injected into the mold to manufacture a neutron shield body 5 having a predetermined shape, a period of time taken in manufacture of the neutron shield body 5 and mounting of the neutron shield body 5 on the inner cylinder 2 can be considerably shortened as compared with the case where a kneaded substance containing a resin is conventionally injected between the inner cylinder 2 and the outer cylinder 3. This leads to considerable shortening of a period of time taken in manufacture of a spent fuel cask 1. Also, since the neutron absorber is distributed uniformly in the axial direction of the spent fuel cask 1, the neutron shielding performance in a radial direction, of the spent fuel cask 1 can be demonstrated uniformly in the axial direction of the spent fuel cask 1. The inner cylinder 2 serves as a radiation shield body

to shield gamma rays emitted from a spent fuel assembly. The gamma rays shielding capacity in a radial direction, of the inner cylinder 2 is made uniform in the axial direction of the spent fuel cask 1. With the spent fuel cask 1 according to the embodiment, the radiation (neutron and gamma rays) shielding capacity can be made uniform in the axial direction of the spent fuel cask 1. Also, with the embodiment, the refractory material in the neutron shield body 5 can be uniformly distributed lengthwise of the neutron shield body 5. Therefore, the refractory material can also be uniformly distributed in density of hydrogen number in the axial direction of the spent fuel cask. Therefore, the neutron shielding capacity of the spent fuel cask 1 is further made uniform in the axial direction of the spent fuel cask 1. The neutron absorber and the refractory material in the radial direction of the spent fuel cask 1 is increased in concentration distribution toward the inner cylinder 2.

[0023] Also, since the neutron shield bodies 5 are arranged in the spaces 28 defined between the heat transfer fins 4 in a state, in which the inner cylinder 2 is laid in a horizontal position, the embodiment makes it possible to easily insert the neutron shield bodies 5 into the spaces 28. With the embodiment, after the neutron shield bodies 5 are inserted into all the spaces 28 defined mutually between all the heat transfer fins 4, the outer cylinder members 29 are mounted on the heat transfer fins 4 to cover the neutron shield bodies. Therefore, since the neutron shield bodies 5 having been arranged in the spaces 28 are held by the outer cylinder members 29 in the embodiment, the neutron shield bodies 5 having been arranged can be prevented from falling off from the spaces 28 in the case where the inner cylinder 2 laid in a horizontal position is rotated in order to arrange the neutron shield bodies 5 in the remaining spaces 28. Therefore, an operation of arranging the neutron shield bodies 5 in the spaces 28 can be performed efficiently. Owing to this, a period of time taken in manufacture of a spent fuel cask 1 can be further shortened.

[0024] According to the invention, a period of time taken in manufacture of a spent fuel cask can be shortened, and besides the radiation shielding capacity in a radial direction, of a spent fuel cask can be made further uniform in an axial direction of a finished spent fuel cask.

[0025] It should be further understood by those skilled in the art that although the foregoing description has been made on embodiments of the invention, the invention is not limited thereto and various changes and modifications may be made without departing from the spirit of the invention and the scope of the appended claims.

Claims

1. A method of manufacturing a spent fuel cask, comprising the steps of:

- injecting a resin and a neutron absorber into a horizontal mold to cure the resin to manufacture a neutron shield body;
 arranging the neutron shield body having been taken out from the mold, outside an inner cylinder, to which a plurality of fins are mounted, and between the fins; and
 mounting an outer cylinder on the fins to cover the neutron shield body.
2. The method according to claim 1, wherein arrangement of the neutron shield body between the fins is performed in a state, in which the inner cylinder is laid in a horizontal position.
3. The method according to claim 2, wherein mounting of the outer cylinder on the fins is performed in a manner to cover the neutron shield body arranged between a part of the fins after the neutron shield body is arranged between the part of the fins mounted on the inner cylinder.
4. The method according to any one of claims 1 to 3, wherein the resin is a thermosetting-type epoxy resin.
5. The method according to any one of claims 1 to 4, wherein a refractory material together with the resin and the neutron absorber is injected into the mold.
6. The method according to claim 4, wherein the epoxy resin contains at least one selected from bisphenol A type epoxy compounds, novolak type epoxy compounds, glycidyl ether type epoxy compounds, glycidyl ester type epoxy compounds, glycidyl amine type epoxy compounds, and biphenyl type epoxy compounds, which serve as a principal ingredient, and at least one selected from amine hardening agents, acid anhydride hardening agents, and imidazole hardening accelerating agents, which serve as a hardening agent for performing ring-opening polymerization of an epoxy radical of the principal ingredient.
7. The method according to claim 5, wherein the refractory material is at least one selected from metalhydroxides, metallic oxide hydrates, inorganic phosphoric acid compounds, organic phosphorus compounds, and halogen compounds.
8. The method according to any one of claims 1 to 7, wherein the neutron absorber is at least one selected from boron compounds, cadmium oxide, gadolinium oxide, and samarium oxide.
9. A spent fuel cask provided with neutron shield bodies, comprising
 an inner cylinder, in which a spent fuel is received;
- a plurality of fins provided in the inner cylinder; neutron shield bodies arranged between adjacent fins; and
 an outer cylinder to cover the neutron shield bodies.
10. The spent fuel cask according to claim 9, wherein the neutron shield bodies are provided by injecting a resin and a neutron absorber into a mold and curing the resin.
11. The spent fuel cask according to claim 10, wherein the resin is a thermosetting-type epoxy resin.

FIG. 1

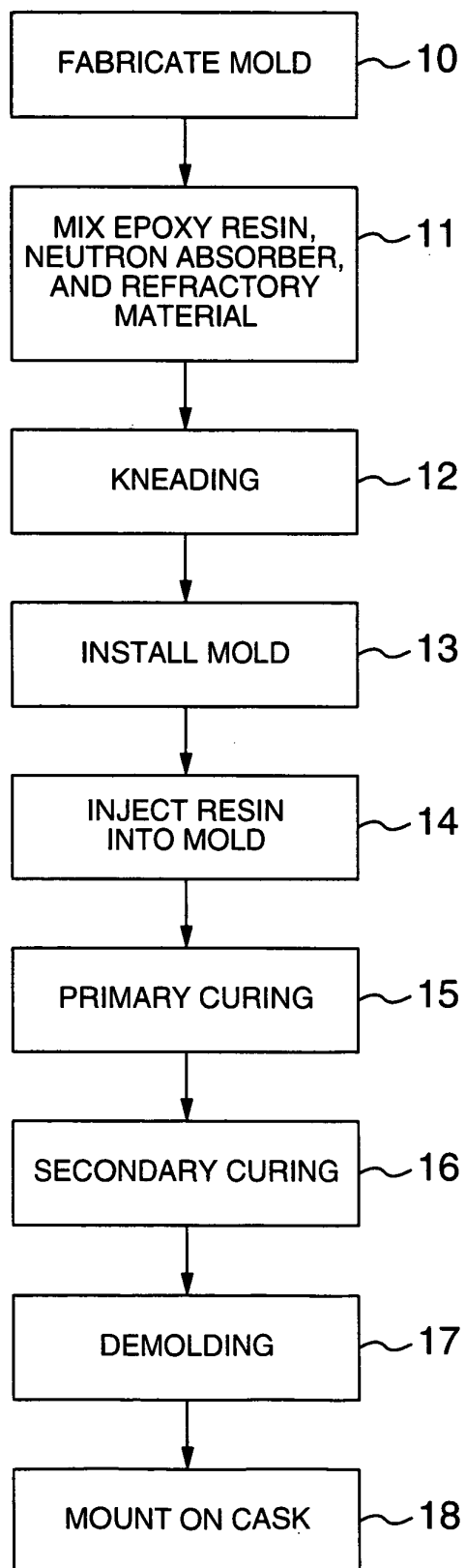


FIG. 2

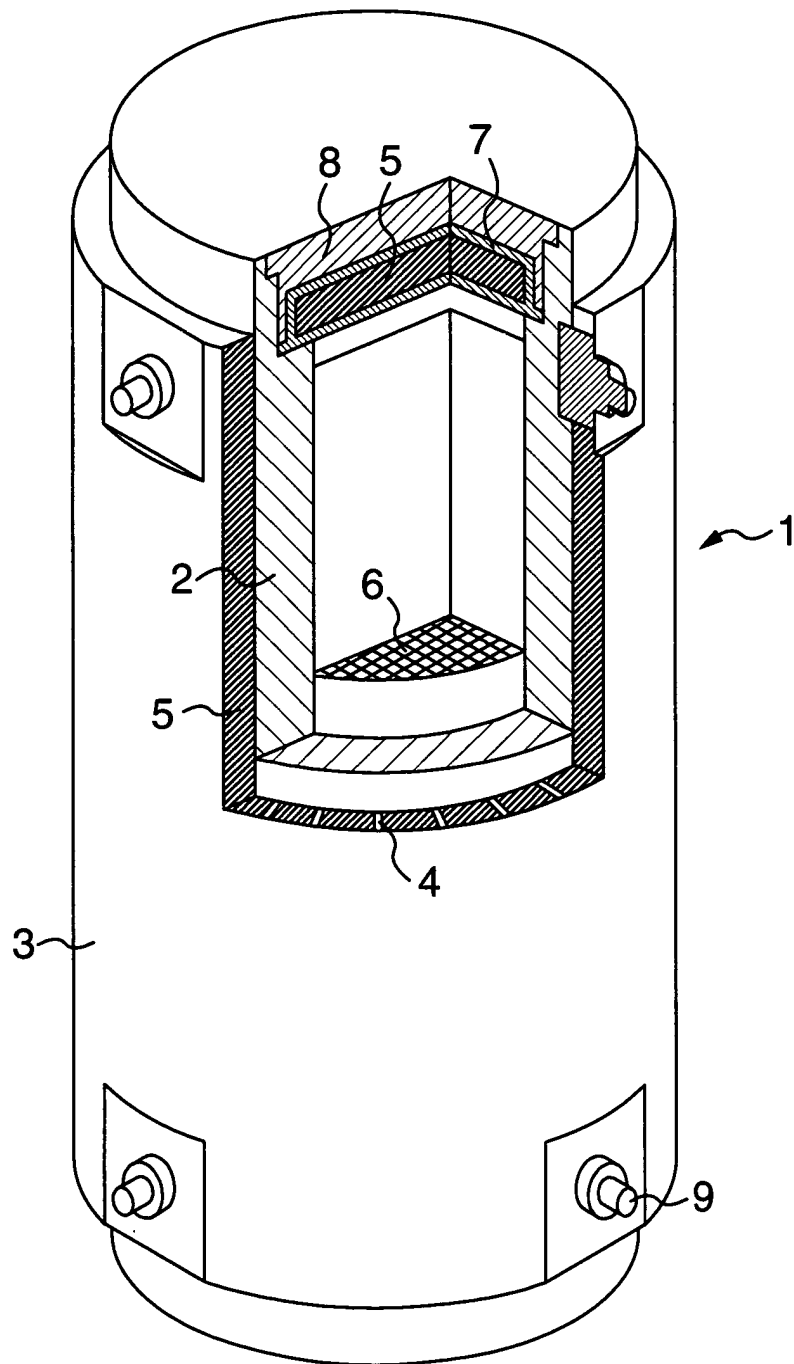


FIG. 3

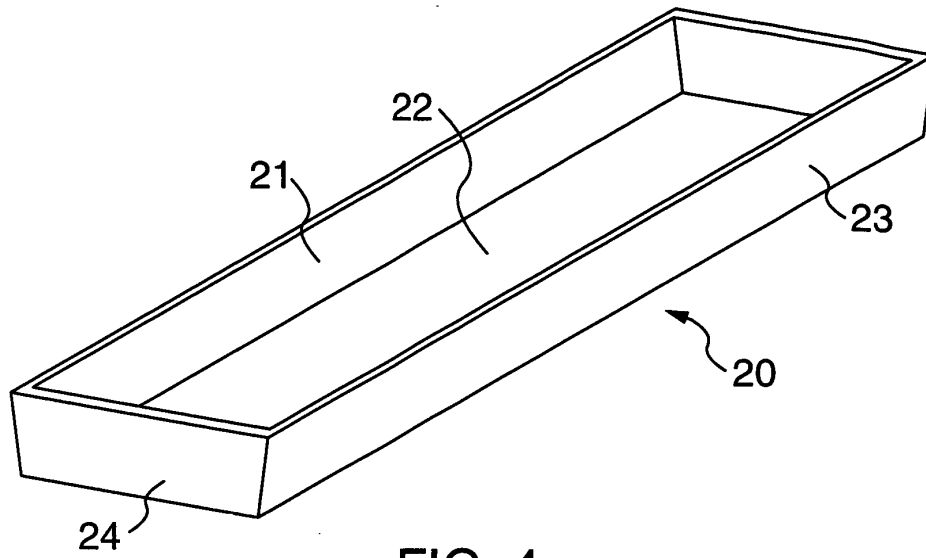


FIG. 4

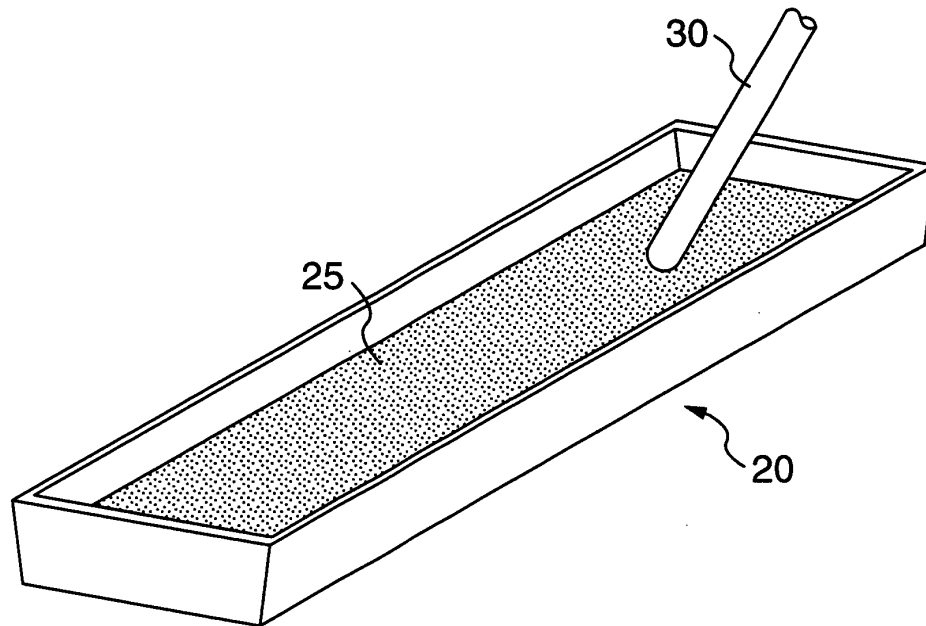


FIG. 5

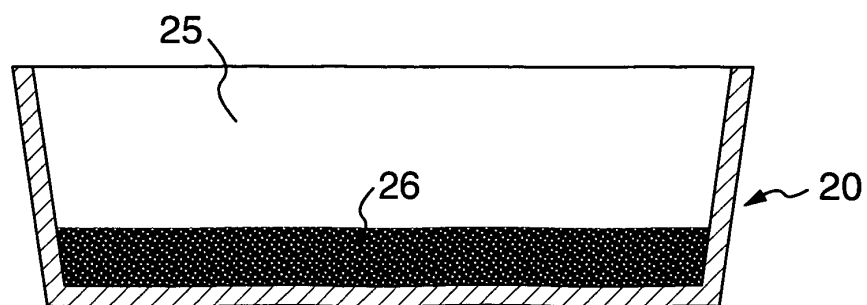


FIG. 6

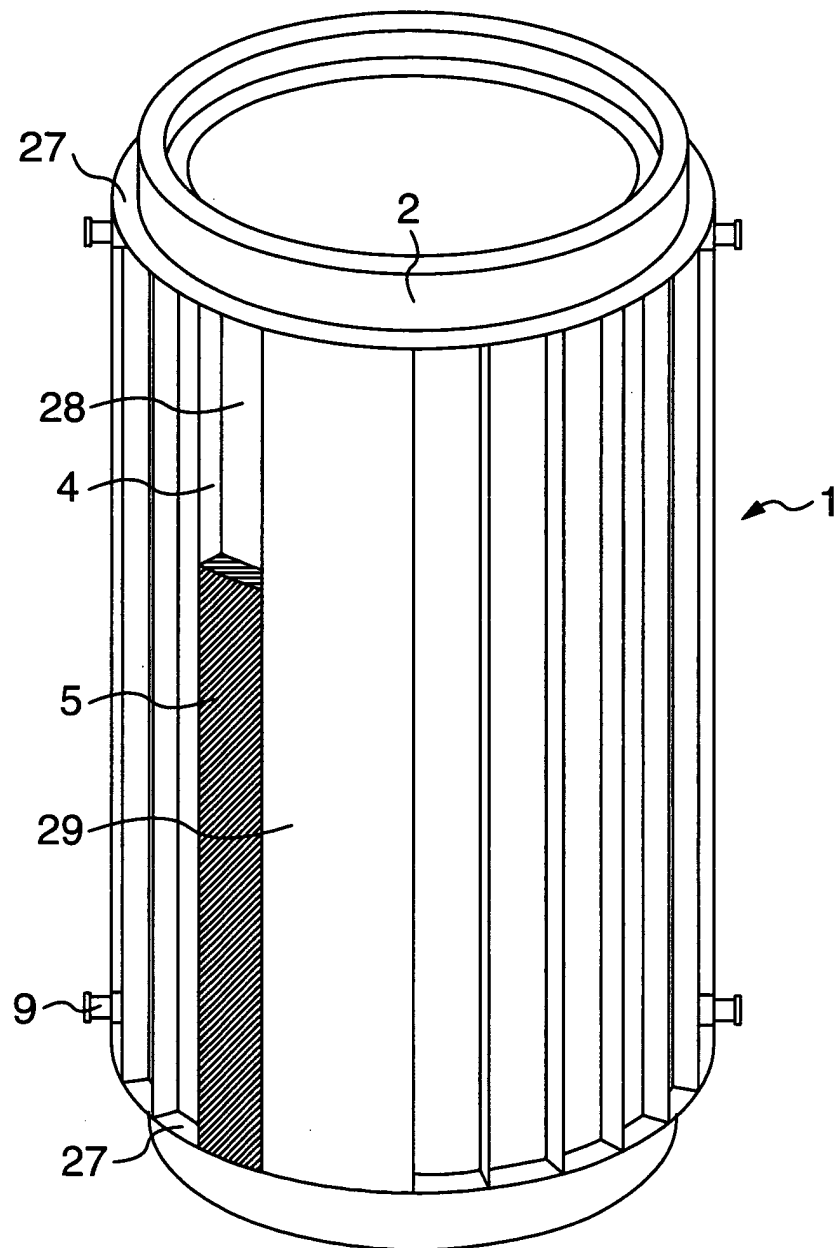


FIG. 7A

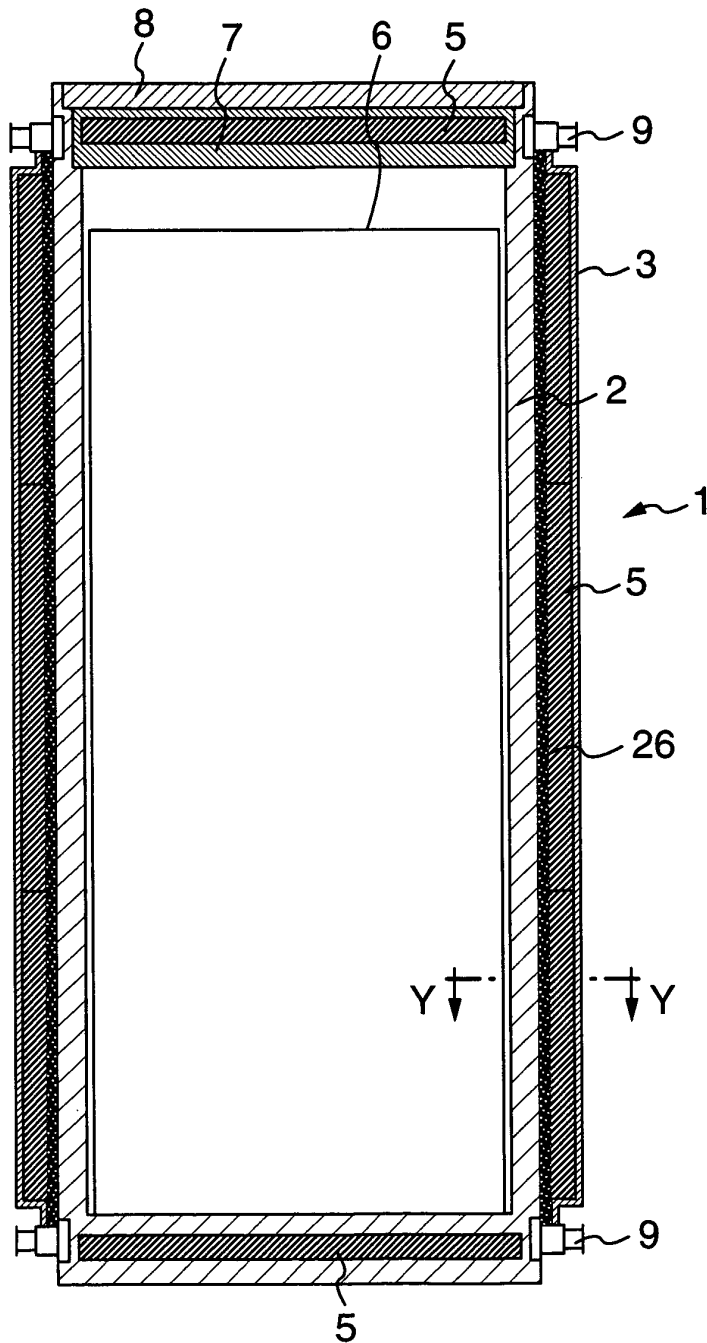
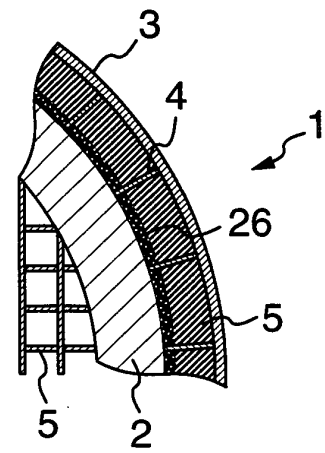


FIG. 7B





European Patent
Office

EUROPEAN SEARCH REPORT

Application Number
EP 03 01 1841

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
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The present search report has been drawn up for all claims			
Place of search MUNICH		Date of completion of the search 26 September 2003	Examiner Deroubaix, P
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

EPO FORM 1503 03 82 (P04C01)



European Patent
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EUROPEAN SEARCH REPORT

Application Number
EP 03 01 1841

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
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			TECHNICAL FIELDS SEARCHED (Int.Cl.7)
The present search report has been drawn up for all claims			
Place of search MUNICH		Date of completion of the search 26 September 2003	Examiner Deroubaix, P
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

EPO FORM 1503 03.82 (P04C01)

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