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(54) METHOD OF MANUFACTURING CAST METAL PRODUCTS, AND MANUFACTURING PLANT

(57) It is an object to provide a method for manufacturing a casting product with a self-hardening mold and a manufacturing foundry plant using the method wherein a shared production line is used in the same foundry plant to allow selecting and implementing either of the full mold process and the wooden pattern process, depending upon the type, and the like, of the product to thereby permit highly efficient production of castings. This object is achieved by disposing a compound multi-function molding line 1 to be sharedly used by the full mold process and the wooden pattern process in the central portion of the foundry plant; providing a casting line on the full mold process and a casting line on the wooden pattern process, sharing the molding line 1; and on the basis of the judgment elements of the shape, material, production lot, and the like, of a casting product of a manufacturing object, allowing either of the casting line on the full mold process and the casting line on the wooden pattern process to be selectively used.

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Description

Technical Field

[0001] The present invention relates to a method for manufacturing a casting product by selectively implementing the full mold (casting) process and the wooden pattern process within a single foundry plant, depending upon the type of a casting product, and a foundry plant for implementing the same method. The term of wooden pattern process used here is a term employed in contrast to full mold process, generically referring to the casting methods using a cavity mold (in contrast to a full mold), such as a ligneous pattern, a metallic pattern, a resin pattern, a shrinkage type expanded resin pattern on a resin shrinkage material contained in kneaded sand, or the like.

Background Art

[0002] Non-volume production type casting manufacturing methods on the basis of the organic self-hardening mold casting process can be divided into two broad general categories: the full mold process and the wooden pattern process. The full mold process is a casting method which pours molten metal into a mold while burning the evaporative expanded pattern to replace it with the molten metal, and the wooden pattern process is a traditional casting method which disposes a core in a mold comprised of a cope half and a drag half, and pours molten metal into the spacing inside the mold.

[0003] The full mold process and the wooden pattern process have inherent advantages and drawbacks, respectively. In other words, the full mold process has such advantages as that there is no need for using a wooden pattern and a core, allowing rapid and low-cost production in case of making a single article or a small number of articles, and eliminating the need for storing the wooden pattern and the core; that the expanded pattern has a good machinability, and expanded pattern making with the use of 3-D solid data or CAD/CAM is possible, which allows producing of a casting having a complicated shape, and in addition, detecting the possible problems at the stage of pattern making for avoiding them, while, the full mold process has such drawbacks as those that there is the need for disposing an evaporation residue which can adhere to the casting; and that, because the expanded pattern has not a sufficiently high strength, resulting in a possibility that the pattern may be deformed at the time of mold sand ramming, thereby measures against such deformation must be taken, which requires a high technical ability, resulting in making it impossible to adopt the full mold process with ease.

[0004] On the other hand, the wooden pattern process has such an advantage as that it can be easily adopted because no high casting techniques are required, however, it has drawbacks, such as that manpower is required for making a wooden pattern and a core; that a draft must be provided, which can involve many design restrictions, thereby the wooden pattern process is not suitable for casting of articles with complicated shapes; and that it is difficult to modify the wooden pattern and the core, and the storage and maintenance thereof is required.

[0005] Thus, the full mold process and the wooden pattern process are casting methods which are fundamentally different from each other in technical concept, and as a matter-of-course, the foundry plant for implementing the full mold process and that for implementing the wooden pattern process have been conventionally separated from each other, and there has existed no concept of handling both casting processes within a single foundry plant.

Citation Literature

Patent Literature

[0006]

Patent document 1: Japanese Unexamined Patent Application Publication No. Hei 5-85603
Patent document 2: Japanese Unexamined Patent Application Publication No. Hei 5-309473
Patent document 3: Japanese Unexamined Patent Application Publication No. 2001-321928
Patent document 4: Japanese Unexamined Patent Application Publication No. 2003-154438
Patent document 5: Japanese Unexamined Patent Application Publication No. 2005-111499

Summary of Invention

Problems to Be Solved by the Invention

[0007] As described above, the full mold process and the wooden pattern process have inherent advantages and drawbacks, respectively, however, in order to make the most of their respective inherent advantages, it is desirable that either the full mold process or the wooden pattern process be used, depending upon the type of product, but because both casting processes are fundamentally different from each other in technical concept, there has been up to now no concept of selectively implementing both casting processes within a single foundry plant.

[0008] The present invention has been made in view of such a situation, and it is an object of the present invention to provide a method for manufacturing a casting product with a self-hardening mold that allows either of the full mold process and the wooden pattern process to be selected and implemented, using a shared production line within the same foundry plant, depending upon the type, and the like, of the product, thereby permitting highly efficient production of castings.

Means for Solving the Problems

[0009] The invention according to claim 1 to solve the aforementioned problems is a method for manufacturing a casting product, the method providing a casting line implementing the full mold process and a casting line implementing the wooden pattern process, using a shared molding line, within a single foundry plant, and on the basis of the judgment elements including the shape, material, and production lot of a casting product as a manufacturing object, allowing selecting either casting process of the full mold process or the wooden pattern process for manufacturing the casting product.

[0010] The invention according to claim 2 to solve the aforementioned problems is a method for manufacturing a casting product, the method selecting, on the basis of the judgment elements including the shape, material, and production lot of a casting product as a manufacturing object, either casting process of the full mold process or the wooden pattern process for manufacturing the casting product by the process selected within a single foundry plant,

in the central portion of the foundry plant, there being disposed a compound multi-function molding line comprising an expanded pattern and wooden pattern setting line, one or more sand mixers, a multi-function manipulator having molding functions of mold inversion, pattern withdrawal, false part withdrawal, mold cope and drag halves assembling, and the like, and a runner box making and setting area; on the pre-process side of the molding line, there being disposed a casting member making space and a casting member storage space; on the post-process side of the molding line, there being disposed a sand ramming molding space, a molten metal pouring, and a disassembling space; on the pre-process side of the molding line, the casting member necessary for implementing a casting process selected from the full mold process and wooden pattern process being supplied to the molding line; on the post-process side of the molding line, a mold to be used for implementing the selected casting process being made; and the mold being used for implementing the selected casting process for manufacturing the casting product.

[0011] The invention according to claim 3 to solve the aforementioned problems is a method for manufacturing casting products, the method selecting, on the basis of the judgment elements including the shape, material, and production lot of a casting product as a manufacturing object, either casting process of the full mold process or the wooden pattern process for manufacturing the casting product by the process selected within a single foundry plant, comprising:

a step of making a casting member including at least a full mold pattern to be used in the full mold process, as well as a casting member including at least a main pattern and a core to be used in the wooden pattern process;

a step of storing the casting member to be used in the full mold process and the casting member to be used in the wooden pattern process in a storage space;

a step of selecting either casting process of the full mold process or the wooden pattern process, on the basis of the judgment elements including the shape, material, and production lot of a casting product as a manufacturing object;

a step of taking out, from the storage space, the casting member to be used in the casting process selected in the selection step;

a step of supplying the casting member taken out in the taking-out step to a compound multi-function molding line comprising an expanded pattern and wooden pattern setting line, one or more sand mixers, a multi-function manipulator having molding functions of mold inversion, pattern withdrawal, false part withdrawal, mold cope and drag halves assembling, and the like, and a runner box making and setting area;

a step of making a completed mold on the molding line;

a step of transferring the completed mold to a molten metal pouring space;

a step of pouring molten metal into the completed mold in the molten metal pouring space; and

a step of disassembling the completed mold for taking out the casting product after solidification and cooling of the molten metal.

[0012] Preferably, before the step of transferring the completed mold to a molten metal pouring space, there is included a step of storing the completed mold in a storage space for putting it in standby until a molten metal pouring call is given in accordance with the molten metal material and the molten metal weight, the transferring of the completed mold to the molten metal pouring space being comprised of taking out the completed mold from the storage space after the molten metal pouring call having been given; molten metal pouring being made at a predetermined molten metal pouring booth; and further a timing adjustment of fuming at the time of molten metal pouring attributable to the mold for the full mold process or the wooden pattern process being made. In addition, the storage space is a multi-story warehouse (a multi-stage storage shelf, hereinbelow means the same).

[0013] The invention according to claim 6 to solve the aforementioned problems is a casting product manufacturing foundry plant, there being disposed, in the central portion thereof, a compound multi-function molding line to be sharedly used by the full mold process and the wooden pattern process, the compound multi-function molding line comprising an expanded pattern and wooden pattern setting line, one or more sand mixers, a multi-function manipulator having molding functions of light-weight or heavy-weight mold inversion, pattern withdrawal, false part withdrawal, mold cope and drag halves as-

sembling, and the like, and a runner box making and setting area; a casting line on the full mold process and a casting line on the wooden pattern process being provided, sharing the molding line; and on the basis of the judgment elements including the shape, material, and production lot of a casting product as a manufacturing object, either of the casting line on the full mold process and the casting line on the wooden pattern process being allowed to be selectively used.

[0014] The invention according to claim 7 to solve the aforementioned problems is a casting product manufacturing foundry plant, the foundry plant allowing selecting and implementing, on the basis of the judgment elements including the shape, material, and production lot of a casting product as a manufacturing object, either casting process of the full mold process or the wooden pattern process for manufacturing the casting product,
in the central portion of the foundry plant, there being disposed a compound multi-function molding line comprising an expanded pattern and wooden pattern setting line, one or more sand mixers, a multi-function manipulator having molding functions of mold inversion, pattern withdrawal, false part withdrawal, mold cope and drag halves assembling, and the like, and a runner box making and setting area; on the pre-process side of the molding line, there being disposed a casting member making space and a casting member storage space; on the post-process side of the molding line, there being disposed a sand ramming molding space, a molten metal pouring space, and a disassembling space; between the storage space and the molding line, there being provided means for taking out, from the casting member storage space, the casting member necessary for implementing a casting process selected from the full mold process and wooden pattern process, and supplying it to the molding line; and between the molding line and the molten metal pouring space, there being provided means for supplying a completed mold made on the molding line to the molten metal pouring space.

[0015] Preferably, on the pre-process side of the molding line, there are disposed at least an expanded pattern and false part making area for full mold casting, a wooden pattern, core mold, and core making area for wooden pattern casting, a multi-story warehouse for receiving and storing expanded patterns, false parts, wooden patterns, core molds and cores, an expanded pattern setting area, and a core setting area; on the post-process side of the molding line, there are disposed at least a sand ramming molding area, a molten metal pouring area, a disassembling area, a melting area, and a multi-stormy warehouse for receiving and storing empty flasks, molten metal unpoured molds and poured molds; and the respective operation areas are connected to one another by an automatic roller conveyor, a truck, and other transferring means to thereby allow transferring a product or an operation part from one area to another.

Advantages of the Invention

[0016] As described above, in accordance with the present invention, a casting line on the full mold process and a casting line on the wooden pattern process, using a shared main portion, are provided within a single foundry plant, thereby on the basis of the judgment elements including the shape, material, and production lot of a casting product as a manufacturing object, either of the full mold process and the wooden pattern process can be selectively implemented.

[0017] With a foundry plant layout for a later described embodiment that is shown in the attached drawings, approx. forty operators can produce 2000 tons per month, working eight hours per day on a one shift schedule, the productivity being 50 tons per man-month, which is approx. four to five times as high as that of the conventional manufacturing method.

Brief Description of the Drawings

[0018]

Figure 1 is a schematic plan view showing an example of layout of a first floor of a foundry plant in accordance with the present invention for implementing a method for manufacturing of a casting product in accordance with the present invention;
Figure 2 is a schematic plan view showing an example of layout of a second floor and a third floor of a foundry plant in accordance with the present invention for implementing a method for manufacturing of casting products in accordance with the present invention; and
Figure 3 is a schematic plan view showing another example of layout of a foundry plant in accordance with the present invention for implementing a method for manufacturing of casting products in accordance with the present invention.

Description of Embodiment

[0019] A method for manufacturing casting products in accordance with the present invention provides a casting line on the full mold process and a casting line on the wooden pattern process, using a shared molding line, within a single foundry plant; and on the basis of the judgment elements including the shape, material, and production lot of a casting product as a manufacturing object, allows selecting either casting process of the full mold process or the wooden pattern process for manufacturing the casting product, and Figure 1 to Figure 3 are schematic plan views showing an example of layout of a foundry plant for implementing this method in accordance with the present invention.

[0020] Hereinbelow, an embodiment for carrying out the present invention will be explained with reference to the drawings. As shown in Figure 1, with a foundry plant

in one embodiment in accordance with the present invention, a compound multi-function molding line 1 including a multi-function manipulator 31 is disposed in the central portion of a first floor of the foundry plant. In this molding line 1, expanded pattern and wooden pattern setting, and sand ramming by a mixer are performed, and further, expanded pattern mold inversion, false part withdrawal and wooden pattern withdrawal operations, surface coating operation for the mold, mold cope and drag halves assembling operation, runner box making and setting, and the like, are performed by the multi-function manipulator 31. In other words, for both the full mold process and the wooden pattern process, the same compound multi-function molding line 1 is used for molding.

[0021] On one side, i.e., on the pre-process side of the molding line 1, there are disposed an expanded pattern making area 2 for full mold casting; a wooden pattern and core making area 3 for wooden pattern casting; a multi-story warehouse (multi-stage storage shelf) 4 for receiving and storing expanded patterns, wooden patterns, core molds and cores; an expanded pattern and wooden pattern setting area 5; and a core setting area 6. The respective operation areas are connected to one another by an automatic roller conveyor, a truck, and other transferring means to thereby allow transferring of respective casting members from one area to another. In addiction, transferring of a full mold pattern, a wooden pattern, and a core from the multi-story warehouse 4 to the respective setting areas in the molding line 1 is performed by the operator controlling the overhead traveling crane.

[0022] In the example shown, in order to secure sufficient spaces for the expanded pattern making area 2 for full mold casting, and for the wooden pattern, core mold and core making area 3 for wooden pattern casting, these areas are provided over three stories (see Figure 2). For example, on the third floor, manufacturing of an expanded pattern, a false part, and the like, and manufacturing of a wooden pattern and a core mold are performed; on the second floor, assembling and repairing an expanded pattern, and manufacturing of a core are performed; and on the first floor, surface coating of an expanded pattern and that of a core are performed. Further, drying of each after the coating is performed on the top receiving shelf in the multi-story warehouse 4.

[0023] On the other hand, on the opposite side, i.e., the post-process side of the molding line 1, a sand ramming molding area 8 and a metal flask and board placing area 9 are disposed; a molten metal pouring area 10, a disassembling area 11, and a melting area 12 are disposed in the order of operational step; and further, a multi-story warehouse 13 for receiving and storing empty flasks, molten metal unpoured molds, and molten metal poured molds, a molten metal pouring standby area for a large-sized mold which cannot be accommodated in the multi-story warehouse 13, and a cooling area 14 for use after molten metal pouring are disposed. Transferring of a mold between operation areas is performed by means of an automatic roller conveyor, a truck, or the like.

[0024] Furthermore, through a pre-shot-blasted product placing area 15, a shot-blasted casting grinding and cleaning area 16, a post-shot-blasted product placing area 17, a casting grinder surface-finishing area 18, a coating area 19, a shipping area 20, and the like, are disposed in the order of operational step, and transferring of a casting product between areas can be made by the operator controlling the overhead traveling crane. In addition, transferring of a metal flask or a board between the metal flask and board storage area 9 and the molding line 1 is performed by the operator controlling the overhead traveling crane. Reference numeral 21 denotes a material banker disposed adjacent to the melting area 12, where material carrying-in, storage, and the like, are performed.

[0025] Any operations in the aforementioned operation areas are synthetically managed by production management software. In other words, first, the expanded pattern, wooden pattern, and core required for the full mold process and the wooden pattern process are previously manufactured in the expanded pattern making area 2 and the wooden pattern and core making area 3 to be stocked in the multi-story warehouse 4, respectively. And, on the basis of the various judgment elements including the shape, material, and production lot of a casting product as a manufacturing object, either casting process of the full mold process or the wooden pattern process is selected.

[0026] When the full mold process is selected, the necessary expanded pattern, false part, and the like, are taken out from the multi-story warehouse 4, and transferred onto the molding board on the automatic roller conveyor on the compound multi-function molding line 1. Then, the necessary metal flask is taken out from the metal flask and board storage area 9; set onto the molding board by controlling the overhead traveling crane; and thereafter, by a continuous mixer, the metal flask is filled with specified kneaded sand.

[0027] After hardening of the casting sand, the full mold is transferred to the multi-function manipulator 31, and is lifted up to be inverted by the multi-function manipulator 31, then the molding board is returned to the expanded pattern and wooden pattern setting area 5. Then from the inverted mold, the false part, and the like, are removed; thereafter, a molten metal pouring board is set at the bottom of the mold; thereafter, it is again returned to the sand ramming molding area 8 in the molding line 1; the cope half of the metal flask extracted from the metal flask and board storage area 9 is set onto the mold by controlling the crane; and the kneaded sand is filled into the cope half of the metal flask by using another mixer, or by moving the same mixer for molding. And further, in the runner box area 25, the necessary runner box for molten metal pouring is manufactured and set to make a completed mold.

[0028] Usually, this completed mold is received and stored in the multi-story warehouse 13 as a molten metal

unpoured mold, being put in standby until a molten metal pouring call is given in accordance with the molten metal material and the molten metal weight. And the step of transferring this completed mold to the molten metal pouring space includes taking out the pertinent completed mold from the multi-story warehouse 13 after the molten metal pouring call having been given; making molten metal pouring at a predetermined molten metal pouring booth; and further a timing adjustment of fuming at the time of molten metal pouring that is attributable to the mold for the full mold process or the wooden pattern process being made.

[0029] On the other hand, the withdrawn false part is returned to the multi-story warehouse 4, or crushed to be recovered and melted together with the expanded resin chips produced at the time of expanded pattern manufacturing for recycle and reuse by a resin manufacturer.

[0030] When the conventional type wooden pattern process is used, the wooden patterns for the cope half and drag half of the mold are taken out from the multi-story warehouse 4, being sequentially set onto the molding board on the same roller conveyor as is used for the full mold process; by controlling the crane, the metal flask is set on the same sand ramming molding area 8 in the molding line 1 as is used for the full mold process; then by the mixer, the kneaded sand is filled; and after the sand being hardened, the mold is transferred to the multi-function manipulator 31.

[0031] Then, by the lift-up operation of the multi-function manipulator 31, the cope half of the mold is separated from the cope half of the pattern, the cope half of the mold being then inverted for surface coating, and set onto the molten metal pouring board on another automatic roller conveyor which is in standby. And thereafter, through the drying furnace 22, the cope half of the mold is transferred onto the core setting conveyor.

[0032] As with the cope half of the mold, the drag half of the mold is separated from the pattern, surface-coated, and set on the molten metal pouring board, which is in standby, by the multi-function manipulator 31, and as with the cope half of the mold, the drag half of the mold is transferred onto the core setting conveyor through the drying furnace 22 for setting the core. The cope half of the pattern and the drag half of the pattern which have been withdrawn are returned to the expanded pattern and wooden pattern setting area 5 for a short while before being again used for molding or transferred to the pattern storage line to be received and stored in the multi-story warehouse 4.

[0033] The core set mold, which is in standby on the core setting conveyor, is again transferred to the multi-function manipulator 31, with the cope half of the flask being first transferred, and the cope half of the flask is lifted up to be inverted by the multi-function manipulator 31, being kept lifted up for standby. The used molten metal pouring board is put in standby on the standby roller until the next mold has come, or by controlling the crane, is returned to the metal flask and board standby location. Then, the drag half of the mold is called from the core setting conveyor to be transferred to the multi-function manipulator 31; the cope half of the mold which is kept lifted up is lowered to cover the drag half of the mold; and after the runner box for molten metal pouring having been set, the mold is transferred to the multi-story warehouse 13.

[0034] Thus, with the method and the foundry plant in accordance with the present invention, the full mold and the wooden pattern-using mold are manufactured with the use of completely the same molding line 1, mixer and multi-function manipulator 31.

[0035] In addition, the respective casting members, the molds, and the materials such as sand, and the like, are automatically transferred at a minimum transfer distance, respectively, except for molten metal pouring operation; the heavy-weight crane is provided as a part of the building, or provided independently of the building, in two places, i.e., for the multi-function manipulator 31 and the disassembling area 11, such that the building structure of the entire foundry plant is of light-weight structure. Further, the dust collecting apparatus 24 is provided in proximity to the dust generating area, thereby the duct distance being held to a minimum. The collected dust, which is extremely small in quantity, is accumulated into a single silo by a pneumatic transportation machine before being reused as a concrete material or a ceramics industry sub-material, or properly processed as industrial wastes in a predetermined area outside the foundry plant and disposed.

[0036] As described above, all the steps in the foundry plant are managed by the production management software, and in the respective steps, the operations are continuously executed at the required time intervals, thereby the production activity is conducted regularly and efficiently.

[0037] In the aforementioned example, the mold internal dimensions (breadth x length x height) is $4000 \times 7000 \times 3000$ at maximum, and $2000 \times 4000 \times 1350$ at minimum, the molding capacity being 2 to 4 built-up molding boxes per hr, while, in an example shown in Figure 3, the mold internal dimensions (breadth x length x height) is $2000 \times 3000 \times 3000$ at maximum, and $1200 \times 1500 \times 500$ at minimum, the molding capacity being 15 built-up molding boxes per hr when the foundry plant is constructed as a fully automatic molding system.

[0038] This example is the same as that given above in basic configuration. In other words, also in an example of layout shown in Figure 3, in the central portion of the foundry plant, a compound multi-function molding line 51 is disposed; on one side thereof, a multi-story warehouse 52 for wooden pattern, expanded pattern, and full mold pattern, and a multi-story warehouse 53 for core and core box are disposed; and on the other side thereof, a multi-story warehouse 54 for empty flask and expanded pattern shrinkage, and a multi-story warehouse 55 for molten metal unpoured mold and poured mold are disposed.

[0039] And in proximity to the multi-story warehouse

52 for wooden pattern, expanded pattern, and full mold pattern, pattern making areas 56, 57 for performing pattern making, pattern repair, and casting plan alteration and modification for the wooden pattern process and the full mold process are disposed. The pattern making areas 56, 57 are provided with an expanded material cutting area 58, a surface coating area 59 and a drying area 60, and further with a wooden pattern and core box making area 61. In addition, in proximity to the multi-story warehouse 53 for core and core box, a core making area 62 for performing core making, surface coating, and withdrawal is provided. The pattern making areas 56, 57 and the core making area 62 are provided over a multi-story as required.

[0040] On the other hand, in proximity to the multi-story warehouse 54 for empty flask and expanded pattern shrinkage, a casting finishing area 64, an automatic disassembling area 65, and a large-sized article floor molding area 66 are provided, and in proximity to the multi-story warehouse 55 for molten metal unpoured mold and poured mold, a molten metal pouring line 67, a molten metal pouring booth 68 for full mold process, and a melting yard 69 are provided.

[0041] In such a layout, a pattern made in the pattern making area 51, 52 is set on the molding board, being put in standby in the multi-story warehouse 4 until a call is given by the production planning section. And, when the production planning section gives a call, the pattern is automatically supplied onto a transportation truck in the molding line 51 by a conveyor 71, being transferred to an empty flask setting manipulator 72. The expanded pattern waste material after the pattern making is crushed by an expanded waste material crushing machine 73, which is provided for recycling, and then transferred to an expanded material melting and molding machine 74 to be melted and formed for reuse.

[0042] In addition, from the multi-story warehouse 54 for empty flask and expanded pattern shrinkage, an empty flask having appropriate dimensions is called out, and the empty flask called out is set onto a pattern transferring board by the empty flask setting manipulator 72, being transferred to the molding line 51 by a truck for being subj ected to the processes of sand ramming, vibration sand ramming, and sand smoothing.

[0043] For a wooden pattern process mold, the mold is subjected to the processes of pattern withdrawal, inversion, surface coating by a plurality of manipulators, and then, after being put in standby in a drying furnace 76 for a short while, the mold is transferred to a core setting area 77, where the core which has been made in the core making area 62 is set. Thereafter, the cope half of the mold and the drag half of the mold are assembled by an automatic mold assembling apparatus 78, and the mold is stored in the multi-story warehouse 55 for molten metal unpoured mold and poured mold.

[0044] For a full mold, the drag half of the mold is molded and hardened in the molding line 51, then being inverted, and, in the inverted state, being lowered onto a molding board to be again transferred to the molding line 51, being put in standby there, by a pattern withdrawal manipulator 81. Then, the cope half of the flask, which has not yet been subjected to sand ramming in the sand ramming area, is set onto the drag half of the mold, which is in standby in the molding line 51, by the withdrawal manipulator 81. And, thereafter, the cope half of the flask is subjected to sand ramming.

[0045] After having been hardened in the molding line 51, the cope and drag halves assembled mold is again set onto the molten metal pouring board by the pattern withdrawal manipulator 81 without being inverted, being then passed through the surface coating line (manipulator 82 for surface coating), the drying line (drying furnace 76), and the automatic mold assembling apparatus 78 to be stored in the multi-story warehouse 55 for molten metal unpoured mold and poured mold.

[0046] In addition, when the pattern which has been separated by the pattern withdrawal manipulator 81 is to be again used for molding, it is transferred to the roller conveyor for the empty flask setting manipulator 72 by a transferring truck, and the empty flask taken out from the multi-story warehouse 54 for empty flask and expanded pattern shrinkage is set onto a molding board by the empty flask setting manipulator 72, the pattern being again circulated into the molding line 51. On the other hand, any pattern which is not to be again used for molding is returned to the multi-story warehouse 4 by the conveyor 71 after being withdrawn.

[0047] The mold with which the expanded pattern is to be shrunk is inverted by the pattern withdrawal manipulator 81, then being transferred to the conveyor 84 by an automatic truck to be put in standby for the necessary time in the multi-story warehouse 54 for empty flask and expanded pattern shrinkage, and after the pattern having been shrunk, the mold is transferred to the surface coating line by the conveyor 84 and a transportation truck from the multi-story warehouse 54 for empty flask and expanded pattern shrinkage. And, the shrunk pattern is withdrawn from the mold by the operator prior to the surface coating step, and crushed by the pattern crushing machine to be transferred to the resin melting apparatus 74, being formed and then recycled.

[0048] Then, by the action of the manipulator 82 for surface coating, the mold is transferred, through the surface coating line, the drying furnace 76, and the automatic mold assembling apparatus 78, to the multi-story warehouse 55 for molten metal unpoured mold and poured mold to be put in standby there until a molten metal pouring call is given.

[0049] The board for transferring the cope half of the flask after the mold matching and the board for transferring the mold after the empty flask setting are transferred by a transferring truck to the surface coating line from the roller conveyor at the bottom of the multi-story warehouse 55 for molten metal unpoured mold and poured mold, respectively.

[0050] For the mold which is called out from the multi-

stormy warehouse 55 for molten metal unpoured mold and poured mold to the molten metal pouring line 67, a runner box is set on the cope half of the flask therefor by the operator in the runner box and clamp setting area 89, and after the cope and drag halves of the mold having been clamped, the mold is transferred to the molten metal pouring line 67, where the molten metal which has been melted in the melting yard 69 is poured into the mold. Then, after the runner box and clamp having been removed by the operator in the runner box and clamp removing area 90, the mold is again put in standby for a predetermined cooling time in the multi-story warehouse 55 for molten metal unpoured mold and poured mold.

[0051] When the molten metal is to be poured into the full mold, the fuming dust is collected at the molten metal pouring booth 68, and thereafter in the runner box and clamp removing area 90, the runner box and clamp are removed by the operator, the mold being returned to the multi-story warehouse 55 for molten metal unpoured mold and poured mold. And therein, after a predetermined cooling time having elapsed, the mold is transferred to the automatic manipulator-equipped disassembling apparatus 65 for unmanned separation of the sand and casting from the mold. The sand is appropriately crushed in that place to be stored in the silo for the sand processing apparatus 85 by the pneumatic transportation apparatus. The separated casting is transferred to the casting finishing yard 64 for the subsequent step by the casting extraction manipulator 86.

[0052] The generated dust is all collected by the respective dust catchers 88, which are provided in proximity, to be transferred to the dust silo by the pneumatic transportation apparatus and shipped as a ceramic industry material, industrial wastes, or the like, for disposal. In addition, every pattern is loaded on the molding board, and every mold after the pattern having been withdrawn is loaded on the molten metal pouring board to be transferred by the roller conveyor, respectively. The transferring in the respective multi-story warehouses is performed in the same manner.

[0053] As described above, for the present invention, it is essential that, when a foundry plant is to be constructed, the pattern making area, the repair area, the core making area and the molding line be disposed in the vicinity of the multi-story warehouse 52 for wooden pattern, expanded pattern, and full mold pattern; the core making area, the surface coating area, the core withdrawal area, and the core setting area be disposed in the vicinity of the multi-story warehouse 53 for core and core box; and the melting yard 69, the molten metal pouring line 67, and the casting finishing yard 64 be disposed in the vicinity of the multi-story warehouse 55 for molten metal unpoured mold and poured mold. And, these disposition locations are those which are within the range of distance allowing the shortest transportation between the respective multi-story warehouses, and which can be selected.

[0054] For implementing casting schemes with all pattern specifications by the full mold process or the wooden pattern process, by disposing the respective processing spaces on the basis of the aforementioned viewpoint, the distance for transportation of a variety of materials required for manufacturing various casting products is made the shortest; the selection and procurement of casting members and materials are made easy; and yet using the same molding line and casting line, a variety of casting products on various casting schemes can be efficiently manufactured.

[0055] In addition, there can sometimes occur a situation where both types of patterns are not available, however, even in such a situation, casting production using a single type of pattern, i.e., either a wooden pattern or a full mold pattern can, of course, be performed (provided that a program has been prepared in prediction of such a situation). Further, the respective pieces of equipment and apparatuses can be freely disposed within the spirit and scope of the respective casting processes, and every disposition is included in the scope of the technical concept of the present invention.

[0056] Hereinabove, the present invention has been explained in detail to some extent, and about the most preferred embodiment, however, since it is obvious that a wide range of different embodiments can be made without departing from the spirit and scope of the present invention, it is to be understood that the present invention is not limited to the specific embodiments thereof except as defined in the appended claims.

Claims

1. A method for manufacturing a casting product, the method providing a casting line implementing the full mold process and a casting line implementing the wooden pattern process, using a shared molding line, within a single foundry plant, and on the basis of the judgment elements including the shape, material, and production lot of a casting product as a manufacturing object, allowing selecting either casting process of the full mold process or the wooden pattern process for manufacturing the casting product.

2. A method for manufacturing a casting product, the method selecting and implementing, on the basis of the judgment elements including the shape, material, and production lot of a casting product as a manufacturing object, either casting process of the full mold process or the wooden pattern process for manufacturing the casting product within a single foundry plant,
in the central portion of the foundry plant, there being disposed a compound multi-function molding line comprising an expanded pattern and wooden pattern setting line, one or more sand mixers, a multi-function manipulator having molding functions of

mold inversion, pattern withdrawal, false part withdrawal, mold cope and drag halves assembling, and the like, and a runner box making and setting area; on the pre-process side of the molding line, there being disposed a casting member making space and a casting member storage space; on the post-process side of the molding line, there being disposed a sand ramming molding space, a molten metal pouring, and a disassembling space; on the pre-process side of the molding line, the casting member necessary for implementing a casting process selected from the full mold process and wooden pattern process being supplied to the molding line; on the post-process side of the molding line, a mold to be used for implementing the selected casting process being made; and the mold being used for implementing the selected casting process for manufacturing the casting product.

3. A method for manufacturing a casting product, the method selecting and implementing, on the basis of the judgment elements including the shape, material, and production lot of a casting product as a manufacturing object, either casting process of the full mold process or the wooden pattern process for manufacturing the casting product within a single foundry plant, comprising:

a step of making a casting member including at least a full mold pattern to be used in the full mold process, as well as a casting member including at least a main pattern and a core to be used in the wooden pattern process;
a step of storing the casting member to be used in the full mold process and the casting member to be used in the wooden pattern process in a storage space;
a step of selecting either casting process of the full mold process or the wooden pattern process, on the basis of the judgment elements including the shape, material, and production lot of a casting product as a manufacturing object;
a step of taking out the casting member to be used in the casting process selected in the selection step from the storage space;
a step of supplying the casting member taken out in the taking-out step to a compound multi-function molding line comprising an expanded pattern and wooden pattern setting line, one or more sand mixers, a multi-function manipulator having molding functions of mold inversion, pattern withdrawal, false part withdrawal, mold cope and drag halves assembling, and the like, and a runner box making and setting area;
a step of making a completed mold on the molding line;
a step of transferring the completed mold to a molten metal pouring space;
a step of pouring molten metal into the completed mold in the molten metal pouring space; and
a step of disassembling the completed mold for taking out the casting product after solidification and cooling of the molten metal.

4. The method for manufacturing a casting product according to claim 3, wherein, before the step of transferring the completed mold to a molten metal pouring space, there is included a step of storing the completed mold in a storage space for putting it in standby until a molten metal pouring call is given, the transferring of the completed mold to the molten metal pouring space being comprised of taking out the completed mold from the storage space after the molten metal pouring call having been given; molten metal pouring being made at a predetermined molten metal pouring booth; and further a timing adjustment of fuming at the time of molten metal pouring attributable to the mold for the full mold process or the wooden pattern process being made.

5. The method for manufacturing a casting product of according to any one of claims 2 to 4, wherein the storage space is a multi-story warehouse.

6. A casting product manufacturing foundry plant, there being disposed, in the central portion thereof, a compound multi-function molding line to be sharedly used by the full mold process and the wooden pattern process, the compound multi-function molding line comprising an expanded pattern and wooden pattern setting line, one or more sand mixers, a multi-function manipulator having molding functions of light-weight or heavy-weight mold inversion, pattern withdrawal, false part withdrawal, mold cope and drag halves assembling, and the like, and a runner box making and setting area; a casting line on the full mold process and a casting line on the wooden pattern process being provided, sharing the molding line; and on the basis of the judgment elements including the shape, material, and production lot of a casting product as a manufacturing object, either of the casting line on the full mold process and the casting line on the wooden pattern process being allowed to be selectively used.

7. A casting product manufacturing foundry plant, the foundry plant allowing selecting and implementing, on the basis of the judgment elements including the shape, material, and production lot of a casting product as a manufacturing object, either casting process of the full mold process or the wooden pattern process for manufacturing the casting product,
in the central portion of the foundry plant, there being disposed a compound multi-function molding line comprising an expanded pattern and wooden pattern setting line, one or more sand mixers, a multi-

function manipulator having molding functions of mold inversion, pattern withdrawal, false part withdrawal, mold cope and drag halves assembling, and the like, and a runner box making and setting area; on the pre-process side of the molding line, there being disposed a casting member making space and a casting member storage space; on the post-process side of the molding line, there being disposed a sand ramming molding space, a molten metal pouring space, and a disassembling space; between the storage space and the molding line, there being provided means for taking out, from the casting member storage space, the casting member necessary for implementing a casting process selected from the full mold process and wooden pattern process, and supplying it to the molding line; and between the molding line and the molten metal pouring space, there being provided means for supplying a completed mold made on the molding line to the molten metal pouring space.

8. The casting product manufacturing foundry plant according to claim 7, wherein, on the pre-process side of the molding line, there are disposed at least an expanded pattern making area for full mold casting, a wooden pattern and core making area for wooden pattern casting, a multi-story warehouse for receiving and storing expanded patterns, wooden patterns, core molds and cores, an expanded pattern setting area, and a core setting area; on the post-process side of the molding line, there are disposed at least a sand ramming molding area, a molten metal pouring area, a disassembling area, a melting area, and a multi-story warehouse for receiving and storing empty flasks, molten metal unpoured molds and poured molds; and the respective operation areas are connected to one another by an automatic roller conveyor, a truck, and other transferring means to thereby allow transferring a product or an operation part from one area to another.

INTERNATIONAL SEARCH REPORT

International application No.
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A. CLASSIFICATION OF SUBJECT MATTER
B22D47/02(2006.01)i, *B22C5/18*(2006.01)i, *B22C9/04*(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
B22D47/02, B22C5/18, B22C9/04

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2010
Kokai Jitsuyo Shinan Koho 1971-2010 Toroku Jitsuyo Shinan Koho 1994-2010

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 61-193767 A (Toyota Motor Corp.), 28 August 1986 (28.08.1986), entire text (Family: none)	1-8
A	JP 5-69116 A (Asahi Tec Corp.), 23 March 1993 (23.03.1993), entire text (Family: none)	1-8
A	JP 8-39187 A (Sekisui Plastics Co., Ltd., Yugen Kaisha Fainkyasutingu Imai), 13 February 1996 (13.02.1996), entire text (Family: none)	1-8

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:
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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
13 April, 2010 (13.04.10)	20 April, 2010 (20.04.10)
Name and mailing address of the ISA/ Japanese Patent Office Facsimile No.	Authorized officer Telephone No.

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REFERENCES CITED IN THE DESCRIPTION

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