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(54) **Title**: A PROCESS FOR PREPARING FOUNDRY SAND AND A SYSTEM THEREFOR

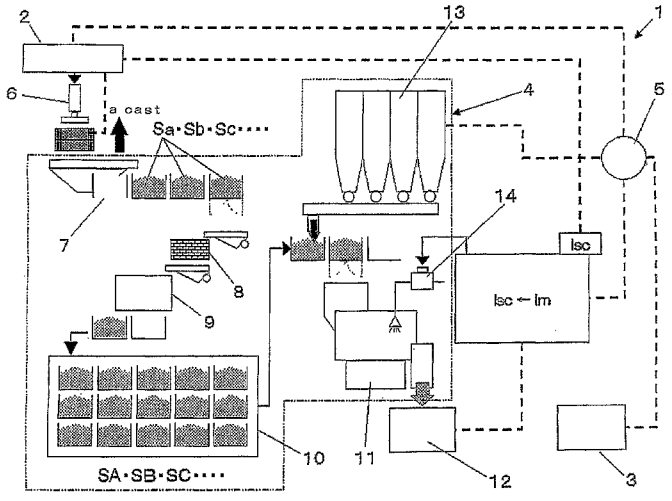


Fig.1

(57) **Abstract**: The objects of the present invention are to solve the problems wherein the properties of the foundry sand vary due to the variations in the weight of the core, the weight of the poured molten metal, the cooling time, the constituents of the sand, and to provide uniform foundry sand to a line for molding. A process is disclosed for preparing foundry sand wherein sand is returned per mold after pouring molten metal and wherein the sand is delivered to a line for molding through a line for preparing the sand. The process comprises the steps of obtaining information for classifying the sand Isc, which includes the constituents of the sand, by using information on a pattern Im; using the information for classifying the sand Isc to identify each batch of the returned foundry sand per mold to be formed; storing the returned foundry sand, for which there is the information for classifying the sand Isc, per mold in a storage room for returned foundry sand; and taking out the returned foundry sand, for which there is the information for classifying the sand Isc, per mold from the storage room for returned foundry sand to mull the sand.

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# DESCRIPTION

## A PROCESS FOR PREPARING FOUNDRY SAND AND A SYSTEM THEREFOR

### Technical Field

[0001]

The present invention relates to a process for preparing foundry sand that is used for casting, and a system for it. More specifically, the present invention relates to a process for preparing foundry sand that utilizes information on a pattern Im, and a system for it.

### Background Art

[0002]

In a conventional process for preparing foundry sand, the first sand, which was subjected to a change in its constituents by being near a cast, and the second sand, which was not substantially subjected to a change in its constituents because it was apart from a cast, are separately returned for being prepared in different processing lines. In the line for processing the second sand the process includes the steps of removing foreign particles (removing iron), cooling the sand, and mulling the sand as the main sand. In the line for processing the first sand the process includes the steps of removing foreign particles (removing iron), cooling the sand, and mulling the sand as the supplementary sand. The line for the first sand after the step of mulling it merges with the line for the second sand at the step of mulling it. A bypass line from the line for molding is connected to the line for the first sand before the step of removing foreign particles. Such a process for preparing foundry sand is known as a process for processing a variety of batches of sand having different constituents that are returned from the line for molding. By the process, uniform foundry sand, i.e., without variations in its quality, is prepared (see JP H5-169187 A, etc.).

By the above process, the foundry sand near a cast and that apart from a cast can be separately returned.

However, the first sand includes sand having cores of various weights、various weights of the poured metal, various cooling times, various constituents of the sand, etc. Thus, uniform sand, i.e., without any variation, is not always obtained. Similar problems exist for the second sand.

In another conventional process, returned foundry sand, of which the quality is unknown, is divided per time segments into a plurality of storage room rooms. The same amount of the sand is continuously taken from each storage room to mull the sand. Thus the variation of the constituents of the sand is suppressed. However, in this process the constituents of the sand in each storage room are varied from time to time, and are unknown. Thus, no sand having a uniform quality is obtained by mulling the sand in this process.

Disclosure of Invention

[0003]

The objects of the process for preparing foundry sand, and the system for it, of the present invention, are to solve the problems of the variations of foundry sand. The variations are caused by the weight of the core, the weight of the poured metal, the cooling time, or the constituents of the sand that are different from one batch of sand to another batch. The objects are also to provide uniform foundry sand with a line for molding, which sand is more uniform than that of conventional sand.

[0004]

To achieve the above objects, provided is a process for preparing the foundry sand of the present invention, where the foundry sand is returned per mold after pouring molten metal, and where the foundry sand is delivered to a line for molding through a line for preparing sand. The process comprises the steps of obtaining information for classifying the sand Isc by using information on a pattern Im; using the information for classifying the sand Isc to identify each batch of returned foundry sand for a mold to be formed; storing the returned foundry sand, for which there is the information for classifying the sand Isc, in a storage room for returned foundry sand; and taking out the

returned foundry sand, for which there is the information for classifying the sand Isc, per mold from the storage room for returned foundry sand to mull the sand. The information for classifying the sand Isc is obtained for each batch of the sand and includes data on the constituents of the sand.

To achieve the above objects the process for preparing the foundry sand of the present invention, where the foundry sand is returned per mold after pouring the molten metal, and where the foundry sand is delivered to a line for molding through a line for preparing sand, is provided. The process comprises the steps of obtaining information for classifying the sand Isc by using information on a pattern Im; using the information for classifying the sand Isc to identify each batch of returned foundry sand for a mold to be formed; storing the returned foundry sand, for which sand there is the information for classifying the sand Isc, in a storage room for returned foundry sand; and taking out the returned foundry sand, for which there is the information for classifying the sand Isc, from the storage room for returned foundry sand to mull the sand. The information for classifying the sand Isc is obtained to a batch of the sand, and includes the data on the constituents of the sand.

[0005]

The wording "information on a pattern Im" means information that is intrinsic to a pattern. The pattern that is used for molding varies with each as-cast product. The parameters for each machine and the casting conditions vary with the pattern. Such information that is intrinsic to a pattern is called "information on a pattern Im." For example, it includes data that are stored in a computer (or a programmable controller, hereafter simply "computer") when forming the pattern, and that are obtained about the mold on the computer as the mold is formed. Thus, the information on a pattern Im is data that "shifts" to follow the mold. Here, the word "shifts" means making information intrinsic to a mold, such as information on a pattern Im, usable at the downstream side where the mold is to move. The data that shift are referred to as "shift data."

The information for classifying the sand Isc specifies the characteristics of the returned foundry sand, which include the constituents of the sand that is obtained from

the information on a pattern Im.

Thus, the present invention is characterized in that the information on a pattern Im is used for preparing foundry sand. The information for classifying the sand Isc is obtained about all returned foundry sand based on the information on a pattern Im, as a mold is formed. A mold is a unit for the preparation of the returned foundry sand. The foundry sand is prepared by using the information for classifying the sand Isc.

[0006]

To achieve the above objects a process is provided for preparing the foundry sand of the present invention, where foundry sand is returned from a mold after pouring molten metal and where the foundry sand is delivered to a line for molding through a line for preparing sand. The process comprises the steps of obtaining information for classifying the sand Isc by using information on a pattern Im; using the information for classifying the sand Isc to identify returned foundry sand for a mold to be formed; storing the returned foundry sand, for which there is information for classifying the sand Isc, in one of a plurality of storage rooms for returned foundry sand; and mixing the returned foundry sand, for which there is the different information for classifying the sand Isc, from the plurality of storage rooms to mull the sand. The information for classifying the sand Isc is obtained about the sand and includes data on the constituents of the sand.

[0007]

Moreover, to achieve the above objects, the process for preparing the foundry sand of the present invention is characterized in that a storage room for returned foundry sand is a hopper made of cloth. Such a hopper is effective for preventing the sand from adhering to the hopper when storing wet returned foundry sand, which otherwise easily adheres.

[0008]

To achieve the above objects, the system for preparing the foundry sand of the present invention comprises a computer to obtain information for classifying the sand Isc about the returned foundry sand by using information on a pattern Im; a storage room for the returned foundry sand for storing it, for which sand there is the information

for classifying the sand Isc; and a sand muller for mulling the sand based on the information for classifying the sand Isc, which is obtained about the returned foundry sand.

[0009]

Moreover, to achieve the above objects, the system for preparing the foundry sand of the present invention comprises a computer to obtain information for classifying the sand Isc about the returned foundry sand by using information on a pattern Im; a storage room for the returned foundry sand for separately storing it, which sand is classified in several classes, for which sand there is the information for classifying the sand Isc; a computer for sending a signal to mix the classified sand in the plurality of the storage rooms; and a sand muller for mulling the sand that is mixed by means of the signal from the computer.

[0010]

To achieve the above objects, the system for preparing foundry sand of the present invention comprises a computer that can correct and revise information on a pattern Im and information for classifying the sand Isc by using data on a line for preparing foundry sand or a line for molding.

[0011]

By the present invention, the constituents of the returned foundry sand may be estimated by using information for classifying the sand Isc, which information is obtainable from information on a pattern Im. Thus, using the information for classifying the sand Isc to identify each batch of the returned foundry sand allows the returned foundry sand to be properly mixed. As a result, a line for molding is provided with uniform foundry sand.

[0012]

The constituents of returned foundry sand may be estimated by using information for classifying the sand Isc, which is obtainable from information on a pattern Im. The information for classifying the sand Isc is used to identify each batch of the returned foundry sand and to store batches of it in different storage rooms. The returned foundry sand, for which there is the information for classifying the sand Isc, is

properly mixed. As a result, a line for molding is provided with uniform foundry sand.

[0013]

Moreover, since the storage room for returned foundry sand is a hopper made of cloth, it is effective for preventing sand from adhering to the hopper when storing wet returned foundry sand, which otherwise adheres easily. Thus, the present invention has many advantages.

[0014]

The basic Japanese patent application, No. 2008-308231, filed December 3, 2008, is hereby incorporated in its entirety by reference in the present application.

The present invention will become more fully understood from the detailed description given below. However, the detailed description and the specific embodiment are illustrations of desired embodiments of the present invention, and are described only for an explanation. Various possible changes and modifications will be apparent to those of ordinary skill in the art on the basis of the detailed description.

The applicant has no intention to dedicate to the public any disclosed embodiment. Among the disclosed changes and modifications, those which may not literally fall within the scope of the present claims constitute, therefore, a part of the present invention in the sense of the doctrine of equivalents.

The use of the articles "a," "an," and "the" and similar referents in the specification and claims are to be construed to cover both the singular and the plural, unless otherwise indicated herein or clearly contradicted by the context. The use of any and all examples, or exemplary language (e.g., "such as") provided herein, is intended merely to better illuminate the invention, and so does not limit the scope of the invention, unless otherwise claimed.

Brief Description of Drawings

[0015]

Fig. 1 is a schematic diagram showing the system for preparing foundry sand and the line for molding of the present invention.

Fig. 2 is a schematic diagram showing an example of the information on the pattern Im of the present invention.

Fig. 3 is a flowchart of the method for preparing foundry sand of an embodiment of the present invention.

Fig. 4 illustrates an embodiment of the hopper made of cloth of the present invention.

Fig. 5 is a side view of the hopper of Fig. 4.

Fig. 6 is a schematic diagram showing another embodiment of the system for preparing the foundry sand and the line for molding of the present invention.

Fig. 7 is a schematic diagram showing another example of the information on the pattern Im of the present invention.

Fig. 8 is a flowchart of the method for preparing foundry sand of another embodiment of the present invention.

Fig. 9 is a schematic diagram showing another example of the information for classifying the sand Isc of the present invention.

Best Mode for Carrying Out the Invention

[0016]

Now the best mode for carrying out the invention is described. The present invention relates to a process for preparing foundry sand where foundry sand is returned from a mold after pouring molten metal to be delivered to a line for molding through a line for preparing the sand. The process comprises the step of obtaining information for classifying the sand Isc, by using information on a pattern Im. The information Isc includes the constituents of the sand, and the information is obtained about the sand. It also comprises the steps of using the information for classifying the sand Isc to identify each batch of the returned foundry sand for a mold to be formed, storing for each mold the returned foundry sand, for which there is the information Isc, in a storage room for returned foundry sand, and taking out the returned foundry sand, for which there is the information Isc, per mold from the storage room to mull the sand. The sand can be

taken out not only per mold, but also for a plurality of molds.

The wording "the constituents of the sand" means the contents or the ratio of the contents of the basic sand, clay, coal dust, starch, water, etc., which are contained in the foundry sand as components that form the foundry sand (green sand). It also includes the contents or the ratio of the contents of thermally denaturalized substances (normally called oolitics), fine particles, etc., which substances are formed on the surfaces of the sand particles during repeated use of the sand.

[0017]

The wording "a line for preparing sand" means all machines in casting facilities that use green sand where the machines carry out the following steps. The steps include taking out a cast from a mold, crushing the mold into sand particles, removing foreign particles from the sand, and cooling it to a proper temperature by adding water to store the sand in a storage room. The steps also include adding the proper amount of water and various additives to the sand taken from the storage room, and mixing and mulling them. The steps also include providing sand to a line for molding the sand. The sand is broken into particles after mulling (the sand in this condition is called mulled sand). The machines contain a storage room for returned sand, a sand muller, a hopper for additives, a device for pouring water, etc.

The wording "a line for molding" means all machines in the casting facilities using green sand where the machines carry out the following steps. The steps include throwing the sand into a vessel that consists of a pattern of a cast to be produced and a flask that receives the sand, and then molding by applying force to the sand. They also include placing a core in the mold, matching the flasks, pouring molten metal into the mold, cooling and solidifying the poured metal in the mold, and taking a cooled cast from the mold. Such machines include a molding machine, an automatic pouring machine, and a machine for taking out a cast. They normally include a machine for forming a gate and a gas vent. There are two patterns, that is, a pattern where a mold is transported with the flasks and a pattern where the flasks are removed from the mold after molding and only the mold is transported.

[0018]

The wording "classify in several classes" means classifying the returned foundry sand in several classes by considering the effect of the information on the pattern Im on the properties of the sand. The sand is classified taking particular note of the amount of the additives, the amount of added water, and the time for mulling the sand. For example, the sand is classified in the following classes returned foundry sand that contains a much higher content of core sand than other batches, sand that has a greater weight of the poured metal and that is subject to a greater thermal effect than other batches, sand that has a lesser weight of the poured metal and that contains less core sand than other batches, the average sand, etc.

The wording "information on classification Ic" means a code for identifying the returned foundry sand that has been classified in several classes. In the embodiment described below, it is denoted as A, B, or C, or 1, 2, or 3.

Moreover, the wording "information for classifying the sand Isc" means the properties (Sa, Sb, Sc, ...) of the returned foundry sand, which properties include the constituents of the sand and which properties are identified by the information on the pattern Im or the information on the classification Ic.

Incidentally, the returned foundry sand S is distinguished by denoting it as SA, SB, SC, etc., in correspondence with the information for classifying the sand Isc.

The wording "a storage room for returned foundry sand" means a facility to store the sand that is obtained by crushing a mold, removing foreign particles, and cooling the sand to a proper temperature by adding water. In the present invention, a storage room for returned foundry sand is a facility that consists of a plurality of vessels for storing the returned foundry sand, for which there is the information for classifying the sand Isc, per mold, or an entire structure of a plurality of vessels for separately storing the sand, for which there is the information Isc, based on the information on classification Ic.

The wording "mull the sand" means the step for mixing and agitating the returned foundry sand with various additives and water after taking the sand from the storage room per mold and kneading it with an additive (bentonite) acting as a binder. Thus, all capabilities of the mold are shown.

[0019]

The First Embodiment

Now the invention is described based on the embodiment. Fig. 1 is a schematic diagram showing the system for preparing the foundry sand and the line for molding that are used in the embodiment of the present invention. In Fig. 1, the line for casting 1 is composed of the line for molding 2 (in some cases an automatic pouring machine 3 may be included) and the line for preparing foundry sand 4. The line for casting 1 is controlled by a computer system, which controls the entire apparatus. A computer 5, which constitutes a part of the computer system, obtains the information for classifying the sand Isc about the returned foundry sand, which is cooled. The computer 5 estimates the information Isc by using the information on the pattern Im.

In the line for preparing foundry sand 4, the mold is shaken out by a machine for taking out a cast 6. The returned foundry sand S, which has the information for classifying the sand Isc, is collected in a vessel for returned sand 7 per mold. After passing through a sieving machine 8 for removing foreign particles and a sand cooler 9 the sand S is stored per the vessel 7 in a storage room for returned foundry sand 10.

The information for classifying the sand Isc is "shifted" as information that is intrinsic to the mold ("shift data") up to the step of shaking out the mold by a machine for taking out a cast 6. Moreover, the "shift data" can be kept until the sand is transported to the storage room for returned foundry sand 10 since the sand passes through the sieving machine 8 for removing foreign particles and the sand cooler 9 per mold.

The line for preparing foundry sand 4 includes a sand muller 11, which mulls the returned foundry sand S that is thrown from the storage room for returned foundry sand 10 on a mold-by-mold basis.

The computer 5 sends the sand muller 11 a signal on the best mulling of the sand based on the information for classifying the sand Isc. The word "best" or the words "to optimize" used here do not necessarily mean the best in a strict sense, but are similar to "good" or "to make better."

Moreover, the information for classifying the sand Isc can be used for

estimating the amount of cooling water needed by the sand cooler 9.

Fig. 2 illustrates an example of the information on the pattern Im that is used in the system for preparing the foundry sand of the present invention. The information on the pattern Im can include not only information that is required for optimizing the production of facilities, but also information that is intrinsic to the cast. It may include the name of the product, the required number of products or molds to be formed, the weight of the product, the material of the product, the temperature of the poured molten metal, the weight of the poured metal, the weight of the core or the weight of the core sand to be mixed in the returned sand, the process for forming the core, the time necessary to cool the molten metal within the mold, etc. In practice, just some of the information may be selected. The information intrinsic to the cast may include the process for forming the core, the yield, the positions and number of vents, the positions and number of gates, etc.

[0020]

Now the operation of the above construction is described. Fig. 3 is a flowchart of the method for preparing the foundry sand of the present invention.

First, the information for classifying the sand Isc, which includes the constituents of the sand, is obtained by using the information on the pattern Im.

Next, the information for classifying the sand Isc is obtained about the returned foundry sand of each mold to be formed. Thus the information Isc is obtained about each mold. Therefore, it corresponds to the returned foundry sand of each mold.

The information on the pattern Im is data that are obtained by the computer 5 to each mold to be formed. The information Im is "shift data" that "shifts" to follow the mold or data that are stored on a memory device (such as a barcode), which follows the mold. Thus, the information for classifying the sand Isc is stored in the computer to be "shifted" by using the information on the pattern Im. The information on the pattern Im can be stored in the computer 5 when the pattern is formed. The returned foundry sand S (the sand SA having one constituent, the sand SB having another constituent, and the sand SC having another constituent), for which there is information for classifying the sand Isc, is collected and transported. Then it is stored in the storage room for

returned foundry sand 10 per mold as the returned foundry sand S, for which there is the information for classifying the sand Isc. As a result, the batches of the returned foundry sand (SA, SB, SC, ...) that have respective parts of information for classifying the sand Isc (Sa, Sb, Sc, ...) are stored in the storage room for returned foundry sand 10 in a state where the batches of the sand are collected in respective vessels 7.

To mull the sand, the returned foundry sand S, for which there is the information for classifying the sand Isc of each mold is thrown into the sand muller 11 by a transportation means (not shown).

The computer 5 sends the sand muller 11 a signal for best mulling the sand based on the information for classifying the sand Isc.

[0021]

Moreover, since the sand muller 11 is connected to a molding machine 12 through a transportation line, a hopper for additives 13, and a device for pouring water 14, the best quality of the contents of the sand and additives (such as bentonite, sea coal, starch, and new sand), and water as necessary, are mixed in the sand muller 11 in accordance with the instructions transmitted by the signal. Thus, the foundry sand having a uniform quality is obtained.

[0022]

As described above, by the present invention, the constituents of the sand can be estimated from the information on the pattern Im, so the best mulling is achieved by using the information for classifying the sand Isc to identify each batch of the returned foundry sand, which information is obtained from the information on the pattern Im. Thus, uniform foundry sand is provided to the line for molding.

[0023]

Moreover, the information on the pattern Im may preferably include the weight of the core. By doing so, the weight of the core sand that is mixed in the returned foundry sand can be estimated. Thus, the amount of water and additives to be added is optimized.

[0024]

The information on the pattern Im may preferably include the weight of the

poured molten metal. By doing so, the loss of the additives by heat in the mulled foundry sand and the temperature of the sand can be estimated. Thus, the amount of water and additives to be added is optimized.

[0025]

Moreover, the information on the pattern Im may preferably include the time required to cool the poured metal. By doing so, the loss of the additives by heat of the molten metal in the mulled foundry sand and the temperature of the sand can be estimated. Thus, the amount of water and additives to be added is optimized.

The additives and water can be added from the hopper for holding additives based on the information for classifying the sand Isc during the step of mulling the sand. By this process, the constituents of the sand, which are unknown when the sand is collected in the conventional process, can be known. Thus, the amount of water and additives to be added is optimized.

[0026]

Since the information for classifying the sand Isc includes information on the thermal effect of the returned foundry sand S, the temperature of the sand can be estimated. The temperature can be used to estimate the amount of water to be supplied to the sand cooler 9.

[0027]

The storage room for the returned foundry sand 10 may be a hopper made of cloth 15, as shown in Fig. 4. The hopper made of cloth 15 shown in Figs. 4 and 5 comprises a frame 16 that is a box-shaped structure of shaped steel, a hopper body 17 attached to the frame 16, and a conveyor belt 18 disposed under the hopper body 17 and attached to the frame 16.

The hopper body 17 is made of a polyester-fiber cloth. It has a shape of an upside-down trapezoid, in which both sides in the longitudinal direction become narrower toward the conveyor belt 18. Its upper and bottom ends are open.

Conventionally, such a hopper is made of steel plates and is heavy. Thus, it requires considerable energy to move it. By making the hopper body of cloth, its weight is reduced and it becomes easier to move it. Thus it is preferably used as the

storage room for the returned foundry sand 10 of the present invention.

Moreover, the adhesion of the sand on the hopper made of cloth is reduced. Thus it is advantageous for storing the returned foundry sand, in case the sand has a high humidity and is adhesive. In Figs. 4 and 5 the hopper 15 is provided with the conveyor belt under the hopper body 17. The conveyor is used to convey the returned foundry sand part by part in the hopper and to take it out. Other mechanisms, such as a mechanism using a valve or a gate, or a vibration feeder, may be used to convey and take out the sand.

[0028]

When the automatic pouring machine 3 is used, the weight of the poured metal, one of the pieces of the information on the pattern Im, may be substituted by the actual weight of the poured molten metal that is poured into the mold. By doing so, the weight of the poured molten metal that is obtained from the actual measurement and that is accurate, can be "shifted." Thus, the loss of the additives by the heat of the molten metal in the mulled foundry sand and the temperature of the sand are accurately estimated. Therefore, the amount of water and additives to be added is quickly and reliably optimized.

[0029]

Moreover, when information on the sand muller 11 (the water content of the returned foundry sand after mulling, the temperature of the sand, the amount of the sand to be mulled, etc.) is input in the computer 5, the information for classifying the sand Isc can be modified or revised by the content of the information on the sand muller 11 and the information on the pattern Im. Thus the best condition of the molding machine 12 for the mulled sand (the pressure and time for throwing the foundry sand, the pressure and time of compacting it, etc.) is estimated. Therefore, a stable molding operation is achieved.

[0030]

When information on the molding machine 12 (the pressure and time of throwing the foundry sand, the pressure and time of compacting it, the thickness of the mold, etc.) is input in the computer 5, the information for classifying the sand Isc can be

modified or revised by using some of the information on the molding machine 12 and the information on the pattern Im. Thus the conditions of the mulled sand that are required for molding can be estimated and the conditions for operating the sand muller 11 are optimized. If the thickness of the mold and properties of the sand to be used for molding (specifically, compactability) are obtainable, the information for classifying the sand Isc can be modified or revised by this information and the information on the pattern Im. Thus the best conditions of the mulled sand for molding can be estimated.

[0031]

The Second Embodiment

Next, another embodiment of the process for preparing foundry sand is described. In this process the returned foundry sand, which has different information for classifying the sand Isc, is stored in pluralities of the storage rooms for returned foundry sand. When mulling the sand, the returned foundry sand, for which there is the different information for classifying the sand Isc, is mixed in its proper amount.

Fig. 6 is a schematic diagram showing the system for preparing foundry sand and the line for molding of the embodiment of the present invention. In Fig. 6 a line for casting 21 is composed of the line for molding 22 (in some cases an automatic pouring machine 23 may be included) and the line for preparing foundry sand 24. The line for casting 21 is controlled by a computer system, which controls all the facilities. A computer 25, which constitutes a part of the computer system, uses the information for classifying the sand Isc to identify each batch of the returned foundry sand, which is cooled. The computer 5 estimates the information Isc by using the information on the pattern Im.

In the line for preparing foundry sand 24, the mold is shaken out by a machine for taking out a cast 26. The returned foundry sand S, which has the information for classifying the sand Isc, is transported per mold by a conveyor 27. Each batch of the returned foundry sand is collected in one of the plurality of storage rooms for the returned foundry sand 28.

The information for classifying the sand Isc is "shifted" as information that is intrinsic to a mold ("shift data") at the step of shaking out the mold by a machine for

taking out a cast 26. Moreover, the "shift data" can be kept until the sand is transported to the storage room for returned foundry sand 28 through the conveyor 27 by the time for the sand to be conveyed to the storage room 28 after the shaking out and by the sequence of the "shift data."

The computer 25 sends a signal for mixing the sand that is separately stored based on the information for classifying the sand Isc. The line for preparing the sand 24 includes a conveyor 29 and a bucket elevator 30, both of which transport the sand, which is properly mixed based on the instructions transmitted by the signal. It also includes a sand muller 31, which mulls the sand that is transported by the conveyor 29 and the bucket elevator 30.

[0032]

Fig. 7 is a diagram showing an example of the information on the pattern Im to be used in the system for preparing the sand of the present invention. The information on the pattern Im includes not only information for optimizing the production of machines in the line for molding to suit the types of products, but also information that is intrinsic to a cast. The information on a pattern Im may include the required number of products or of the molds to be formed, the weight of the product, the temperature of the poured molten metal, the weight of the poured metal, the weight of the core or the weight of the core sand to be mixed in the returned sand, the process for forming the core, the time to cool the molten metal within the mold, the material of the product, etc. In practice, just some of the information may be selected. The information intrinsic to the cast may include the process for forming the core, the name of the product, the yield, the positions and number of vents, the positions and number of gates, etc.

[0033]

Now the operation of the above construction is described. Fig. 8 is a flowchart of the method for preparing the foundry sand of the present invention.

First, the information for classifying the sand Isc, which is information on classification Ic for classifying the constituents of the sand, and is used to identify the sand, is obtained by using the information on the pattern Im. The information Isc is obtained about the sand. Fig. 9 is a schematic diagram illustrating the information for

classifying the sand Isc to be used in the system for preparing the sand of the present invention. The returned sand is classified based on the factors that affect the amount of additives to be added, the amount of water to be added, the time that it takes to mull the sand, and so on. The factors may be the weight of the core, the weight of the poured molten metal, the time to cool the molten metal, etc.

For example, based on the weight of the core and the weight of the poured molten metal of the information on the pattern Im as shown in Fig. 7, the constituents of the sand can be classified. There are preferably 3 to 10 classes. An example having four classes is described. The information for classifying the sand Isc (Sa、Sb、Sc、Sd), which information is used to obtain the information on the classification Ic (A, B, C, D) about the sand, is input in the computer. For example, the class SA is the returned foundry sand, which contains a much higher content of core sand than other batches of sand, the class SB is the sand that has a greater weight of the poured metal and is subject to a higher thermal effect than other batches, the class SC is the sand that has a smaller weight of the poured metal and contains less core sand than other batches, and the class SD is the standard sand, i.e., other than the three former classes.

Next, the information for classifying the sand Isc is used to identify the returned foundry sand for a mold to be formed. By doing so, the information for classifying the sand Isc corresponds to the returned foundry sand of the mold.

The information on a pattern Im is data on the computer 5 that are given to each mold to be formed. It "shifts" to follow the mold ("shift data"). Thus, the information for classifying the sand Isc is stored in the computer by using the information on the pattern Im, and is "shifted." The information on the pattern Im can be stored in the computer 25 when the pattern is formed.

The returned foundry sand S, for which there is the information Isc, which sand is collected and transported by the conveyor 27 (the sand SA having a certain constituent, the sand SB having another constituent, and SC...), is stored in a plurality of storage rooms for the batches of the returned foundry sand 28A, 28B, and 28C as the returned foundry sand having the respective pieces of information Isc. Incidentally, since the embodiment in Fig. 6 has only three storage rooms, the returned foundry sand

SD, which is the standard sand, may be stored in the storage room SA, SB, or SC, that has constituents that are the most similar. It is apparent that the number of storage rooms for returned foundry sand is changeable so as to construct the system of the present invention.

A conveyor 29 is provided under the storage rooms 28A, 28B, and 28C. The end of the conveyor 29 is connected to the sand muller 31 through the bucket elevator 30.

The proper amounts of the returned foundry sand, for which there is the different information Isc, from the plurality of storage rooms are mixed when mulling the sand. The classified sand from the plurality of storage rooms 28A, 28B, and 28C is mixed. For this object, a signal such as "SA is ten units, SB is eight units, and SC is six units," is sent by the computer 25 to mix the sand from the plurality of storage rooms.

[0034]

Moreover, the sand muller 31 is connected to a conveyor 33 that is connected to the line for molding 22, to the hopper for additives 34, and to a device for pouring water 35. Thus, the best amounts of the returned foundry sand and additives (such as bentonite, sea coal, starch, new sand), and water as required, are mixed in the sand muller 31. In this way uniform foundry sand, i.e., without variations, is obtained.

[0035]

The information for classifying the sand Isc is "shifted" as the data intrinsic to each mold up to the step of shaking out a cast by the machine for taking out a cast 26. Until the sand is conveyed to the storage room for the returned foundry sand 28 by the conveyor 27 after the step of shaking out the cast, the information Isc can be kept by the time for the sand to be conveyed to the storage room 28 after shaking out the cast, and by the sequence of the "shift data."

However, when a device having a large reservoir, such as a cooling drum, is installed at the downstream side of the machine for taking out a cast, the sand may be mixed with the sand of the previous or next mold. In such a case, since the information that is "shifted" up to the step of shaking out a cast is turned over in the

reservoir, the accuracy of the information on classification Ic deteriorates.

In this case, the additives (such as bentonite) may be added by the hopper for additives 34B at an earlier stage (before the returned foundry sand is mixed).

The present invention is not restricted by the number of lots when regular products are continuously manufactured. The present invention is applicable to such a case where only one lot of the products is manufactured.

[0036]

As described above, by the present invention the constituents of the returned foundry sand are estimated from the information on the pattern Im. Thus, by obtaining the information for classifying the sand Isc about the sand, the plurality of the batches of the returned foundry sand, for which there is the information for classifying the sand Isc, can be optimally mixed. As a result, uniform foundry sand is provided to the line for molding.

[0037]

The information on the pattern Im may preferably include the weight of the core. By doing so, the amount of the core sand, which is mixed in the returned foundry sand, can be estimated. Thus, the amount of the additives and water can be optimized.

[0038]

In addition, the information on the pattern Im may preferably include the weight of the poured molten metal. By doing so, the loss of the additives by the heat in the mulled foundry sand and the temperature of the sand are estimated. Thus, the amount of water and additives to be added is optimized.

[0039]

Moreover, the information on the pattern Im may preferably includes the time that is taken to cool the sand. By doing so, the loss of the additives by the heat in the mulled foundry sand and the temperature of the sand are estimated. Thus, the amount of water and additives to be added is optimized.

The additives and water can be added from the hopper for additives based on the information for classifying the sand Isc during the step of mulling the sand. By

this process, the constituents of the sand, which are unknown when the sand is collected in the conventional process, can be known. Thus, the amount of water and additives to be added is optimized.

[0040]

The storage room for returned foundry sand 28 may be a hopper made of cloth 15, as shown in Fig. 4. The hopper made of cloth 15 shown in Figs. 4 and 5 comprises a frame 16 that is a box-shaped structure of shaped steel, a hopper body 17 attached to the frame 16, and a conveyor belt 18 disposed under the hopper body 17 and attached to the frame 16.

The hopper body 17 is made of a polyester-fiber cloth. It has a shape of an upside-down trapezoid, in which both sides in the longitudinal direction become narrower toward the conveyor belt 18. Its upper and bottom ends are open.

Conventionally, such a hopper is made of steel plates and is heavy. Thus, it requires considerable energy to move it. By making the hopper body of cloth, its weight is reduced and it becomes easier to move it. Thus it is preferably used as a storage room for the returned foundry sand 28 of the present invention.

Moreover, the adhesion of the sand on the hopper made of cloth is reduced. Thus it is advantageous for storing the returned foundry sand, in case the sand has a high humidity and is adhesive. In Figs. 4 and 5 the hopper 15 is provided with the conveyor belt under the hopper body 17. The conveyor is used to convey the returned foundry sand part by part in the hopper and take it out. Other mechanisms, such as a mechanism using a valve or a gate, or a vibration feeder, may be used to convey the sand part by part and take it out.

[0041]

When the automatic pouring machine 23 is used, the weight of the poured metal, one of the pieces of the information on the pattern Im, may be substituted by the actual weight of the poured molten metal that is poured into the mold. By doing so, the weight of the poured molten metal that is obtained from the actual measurement and that is accurate can be "shifted." Thus, the loss of the additives by the heat of the molten metal in the mulled foundry sand and the temperature of the sand are more

accurately estimated. Therefore, the amount of water and additives to be added is quickly and reliably optimized.

[0042]

In the above embodiment, the computers 5, 25 may be controlled centrally or non-centrally. Any number of storage rooms for returned foundry sand may be provided for. The method of obtaining the information for classifying the sand Isc from the information on the pattern Im is not limited to the method of the embodiment.

# CLAIMS

1. A process for preparing foundry sand wherein sand is returned per mold after pouring molten metal and wherein the sand is delivered to a line for molding through a line for preparing the sand, the process comprising the steps of:

obtaining information for classifying the sand Isc, which includes constituents of the sand, by using information on a pattern Im;

using the information for classifying the sand Isc to identify each batch of the returned foundry sand per mold to be formed;

storing the returned foundry sand, for which there is the information for classifying the sand Isc, per mold in a storage room for returned foundry sand; and

taking out the returned foundry sand, for which there is the information for classifying the sand Isc, per mold from the storage room for returned foundry sand to mull the sand.

2. A process for preparing foundry sand wherein sand is returned per mold after pouring molten metal and wherein the sand is delivered to a line for molding through a line for preparing the sand, the process comprising the steps of:

obtaining information for classifying the sand Isc, which includes constituents of the sand, by using information on a pattern Im;

using the information for classifying the sand Isc to identify each batch of the returned foundry sand per mold to be formed;

storing the returned foundry sand, for which there is the information for classifying the sand Isc, per mold in a storage room for returned foundry sand; and

taking out the returned foundry sand, for which there is the information for classifying the sand Isc, from the storage room for returned foundry sand to mull the sand.

3. The process for preparing foundry sand of claim 1, wherein the information on a pattern Im includes a weight of a core.

4. The process for preparing foundry sand of claim 3, wherein the information on a pattern Im includes a weight of poured molten metal.

5. The process for preparing foundry sand of claim 4, wherein the information on a pattern Im includes a time taken for cooling.

6. A process for preparing foundry sand wherein sand is returned per mold after pouring molten metal and wherein the sand is delivered to a line for molding through a line for preparing the sand, the process comprising the steps of:

obtaining information for classifying the sand Isc, which includes constituents of the sand, by using information on a pattern Im;

using the information for classifying the sand Isc to identify each batch of the returned foundry sand per mold to be formed;

storing the returned foundry sand, for which there is the information for classifying the sand Isc, in a plurality of storage rooms for returned foundry sand; and

mixing the returned foundry sand, for which there is the different information for classifying the sand Isc, from the plurality of the storage rooms for returned foundry sand to mull the sand.

7. The process for preparing foundry sand of any one of claims 1 to 6, wherein the storage room for returned foundry sand is a hopper made of cloth.

8. The process for preparing foundry sand of any one of claims 1 to 6, wherein additives or water are added from a hopper for additives by using the information for classifying the sand Isc when mulling the sand.

9. A system for preparing foundry sand comprising:

a computer for obtaining information for classifying sand Isc about returned foundry sand by using information on a pattern Im;

a storage room for returned foundry sand for storing the returned foundry sand, for which there is the information for classifying the sand Isc; and

a sand muller for mulling the returned foundry sand based on the information for classifying the sand Isc that is obtained about the returned foundry sand.

10. A system for preparing foundry sand comprising:

a computer for obtaining information for classifying sand Isc about a plurality of batches of returned foundry sand by using information on a pattern Im;

a plurality of storage rooms for returned foundry sand for separately storing the returned foundry sand, for which there is the different information for classifying the sand Isc, which sand has different constituents;

a computer for giving a signal for mixing the returned foundry sand that is stored in the plurality of storage rooms for returned foundry sand; and

a sand muller for mulling the returned foundry sand that is mixed based on the signal.

11. The system for preparing foundry sand of claim 9 or claim 10 further comprising:

a computer that can correct or revise information on a pattern Im or information for classifying the sand Isc by using data on a line for preparing foundry sand or a line for molding.

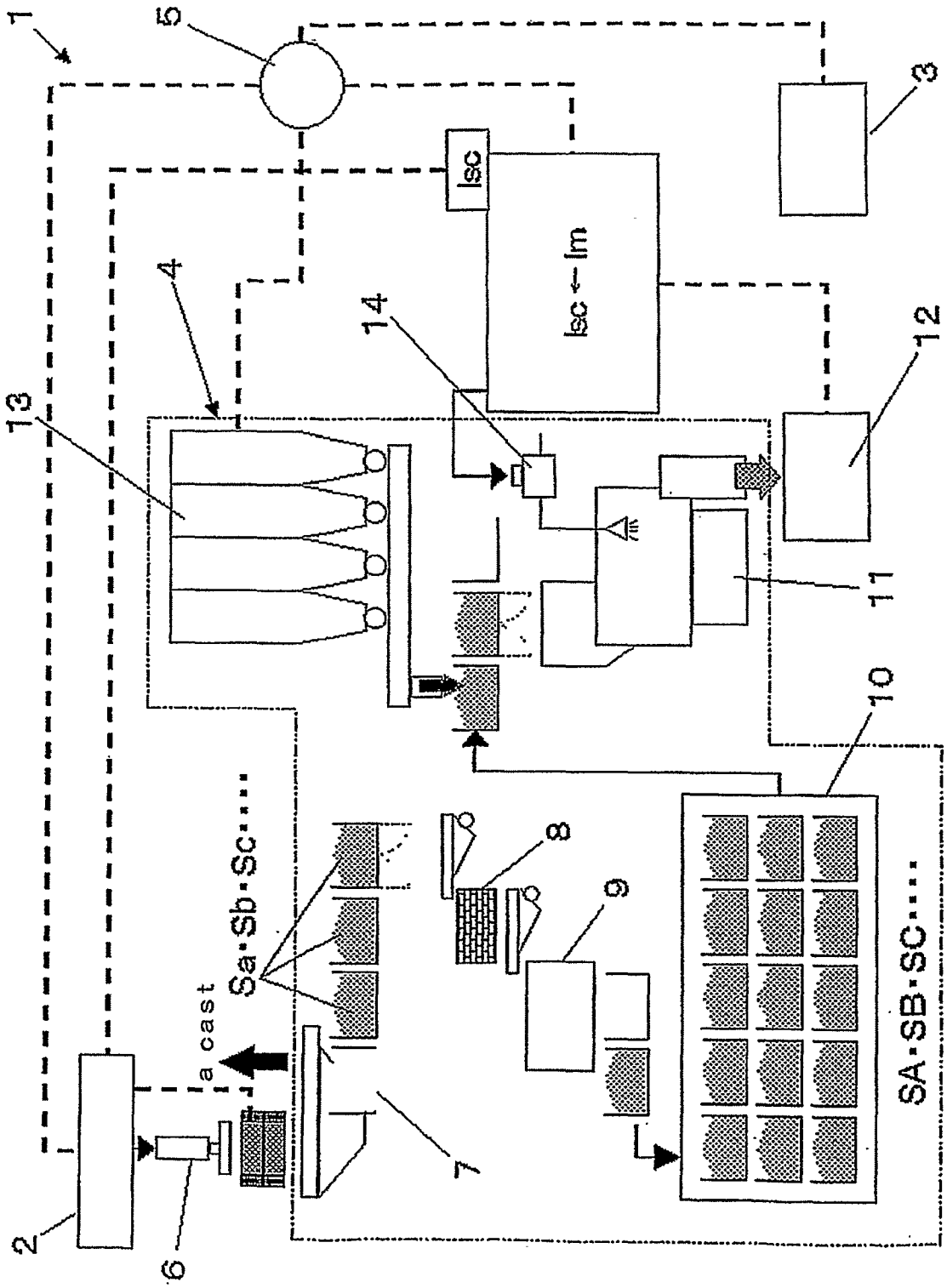



Fig.1

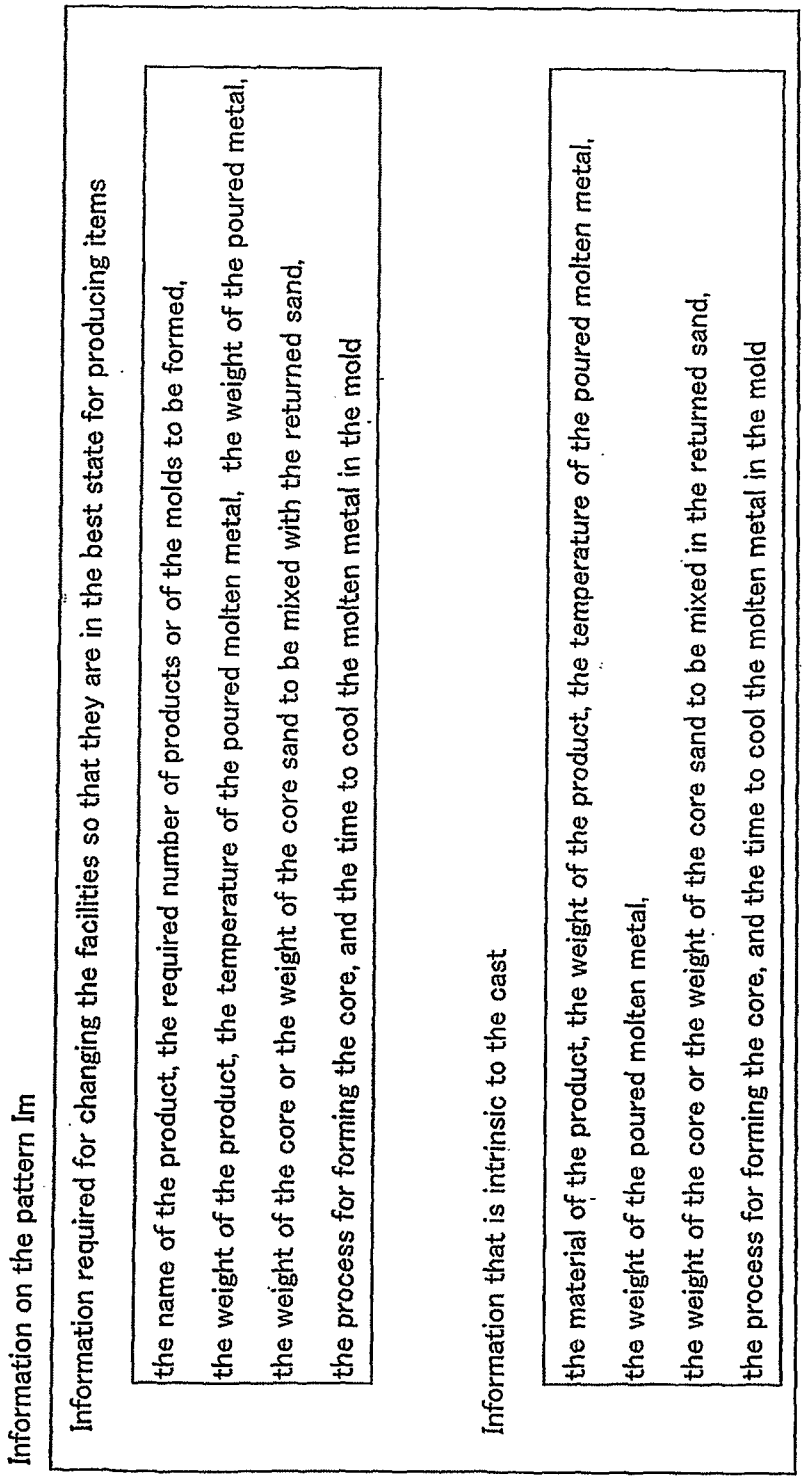

Information on the pattern Im
Information required for changing the facilities so that they are in the best state for producing items
the name of the product, the required number of products or of the molds to be formed,
the weight of the product, the temperature of the poured molten metal, the weight of the poured metal,
the weight of the core or the weight of the core sand to be mixed with the returned sand,
the process for forming the core, and the time to cool the molten metal in the mold
Information that is intrinsic to the cast
the material of the product, the weight of the product, the temperature of the poured molten metal,
the weight of the poured molten metal,
the weight of the core or the weight of the core sand to be mixed in the returned sand,
the process for forming the core, and the time to cool the molten metal in the mold

Fig.2

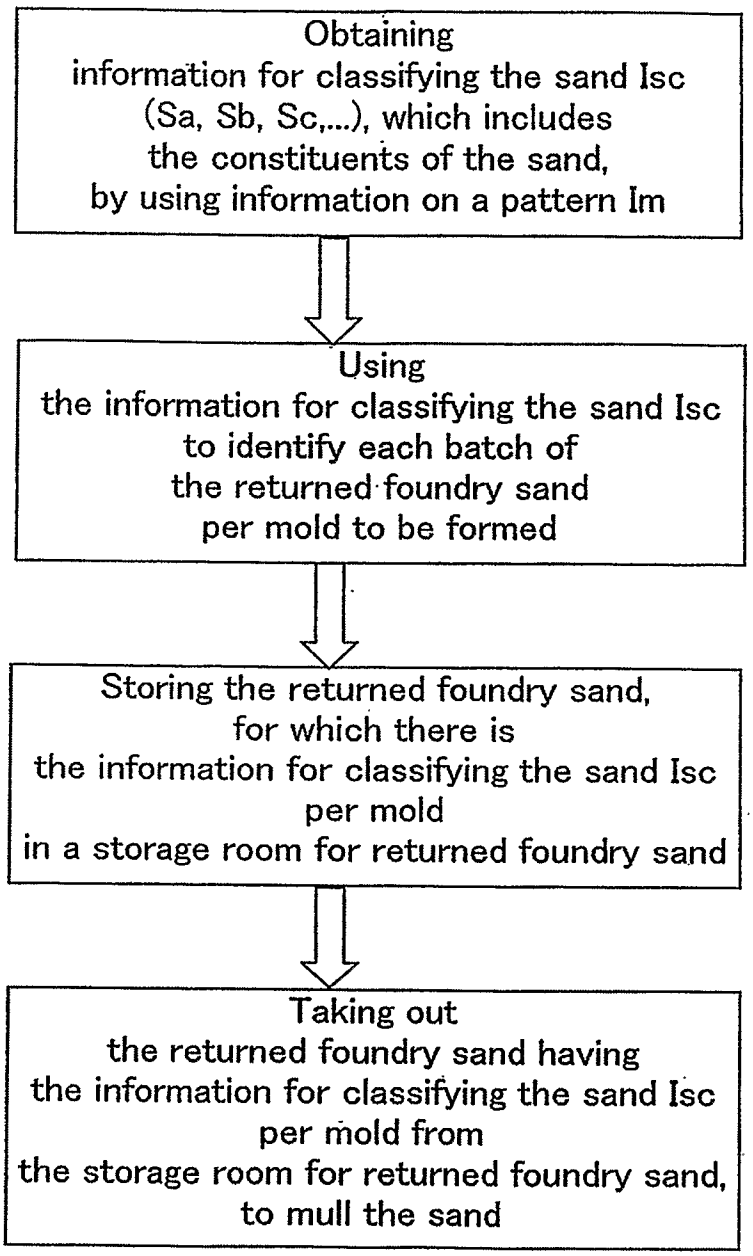

Obtaining
information for classifying the sand Isc
(Sa, Sb, Sc,...), which includes
the constituents of the sand,
by using information on a pattern Im
Using
the information for classifying the sand Isc
to identify each batch of
the returned foundry sand
per mold to be formed
Storing the returned foundry sand,
for which there is
the information for classifying the sand Isc
per mold
in a storage room for returned foundry sand
Taking out
the returned foundry sand having
the information for classifying the sand Isc
per mold from
the storage room for returned foundry sand,
to mull the sand

Fig.3

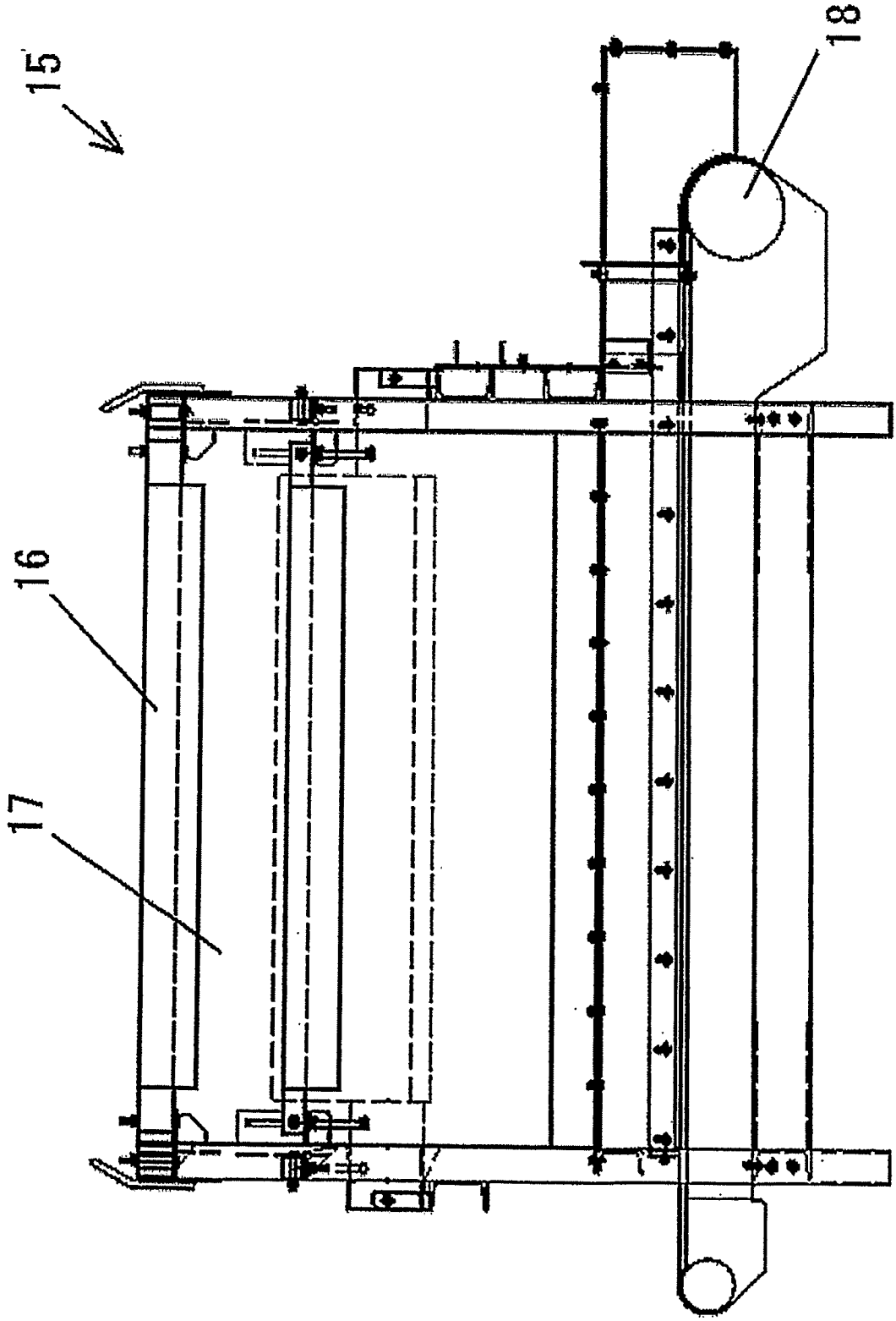



Fig.4

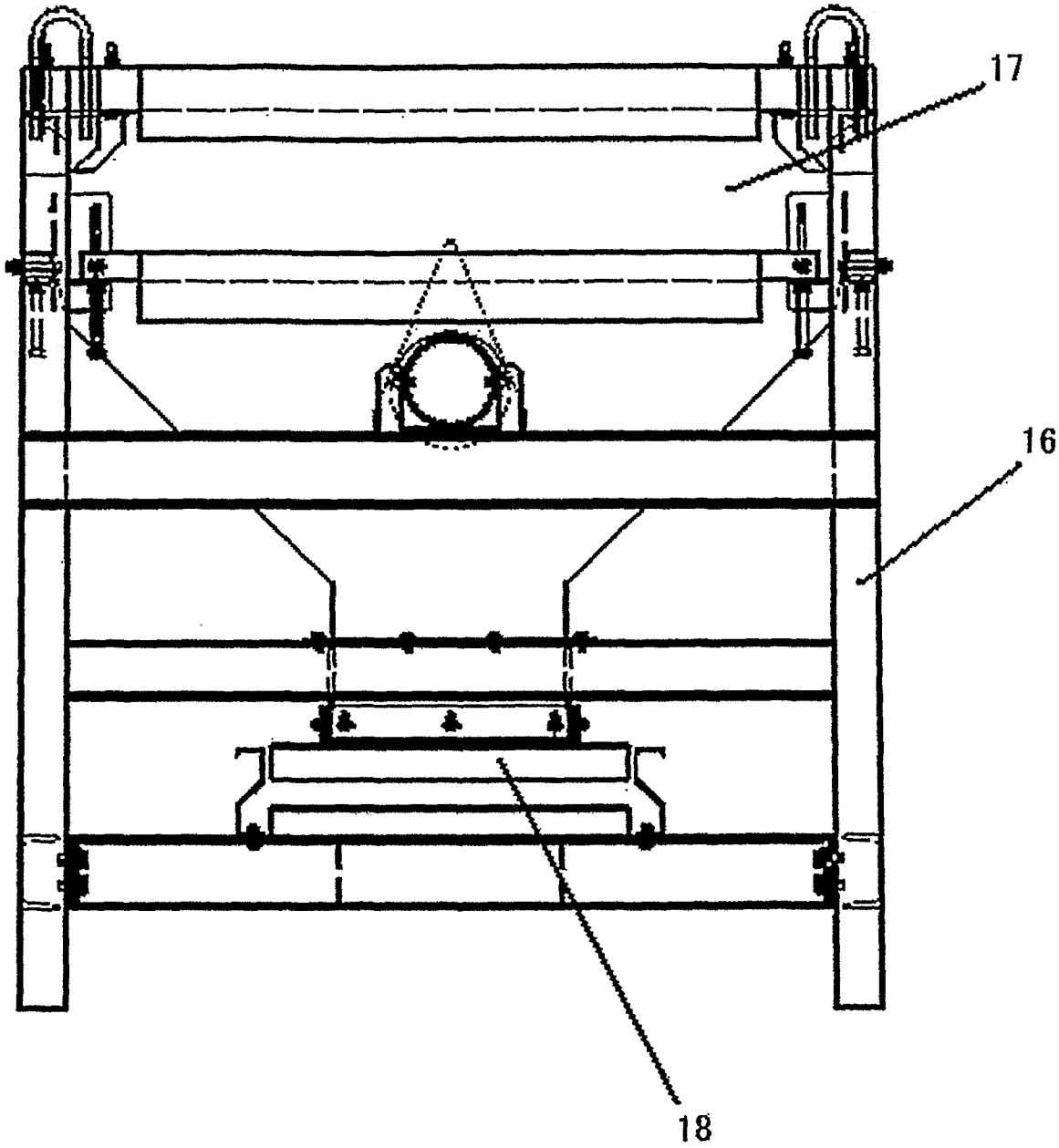
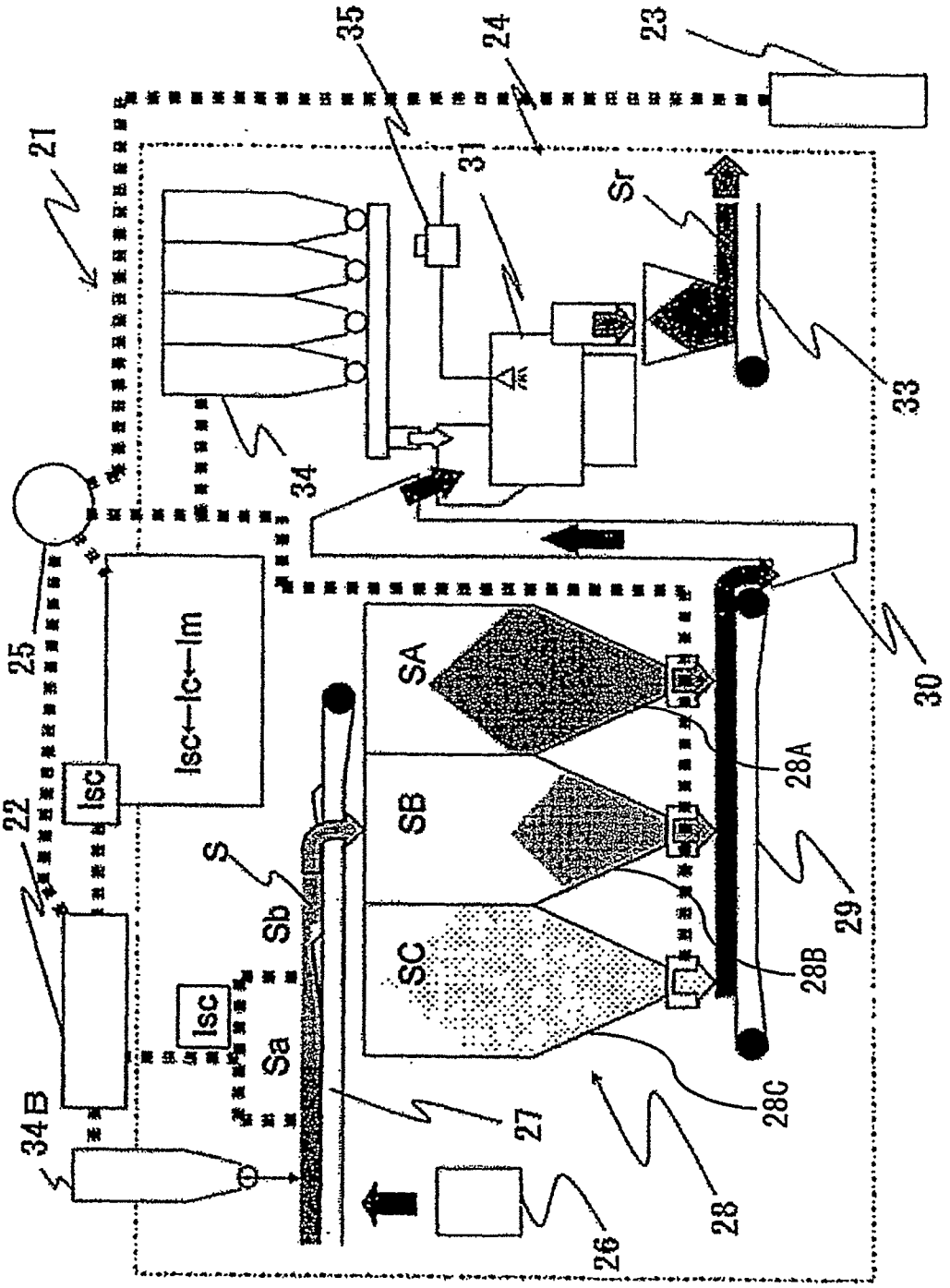



Fig.5


21
22
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24
25
26
27
28
28A
28B
28C
29
30
31
33
34
34B
35
Sr
S
Sa
Sb
SA
SB
SC
Isc
Isc←Ic←Im

Fig.6

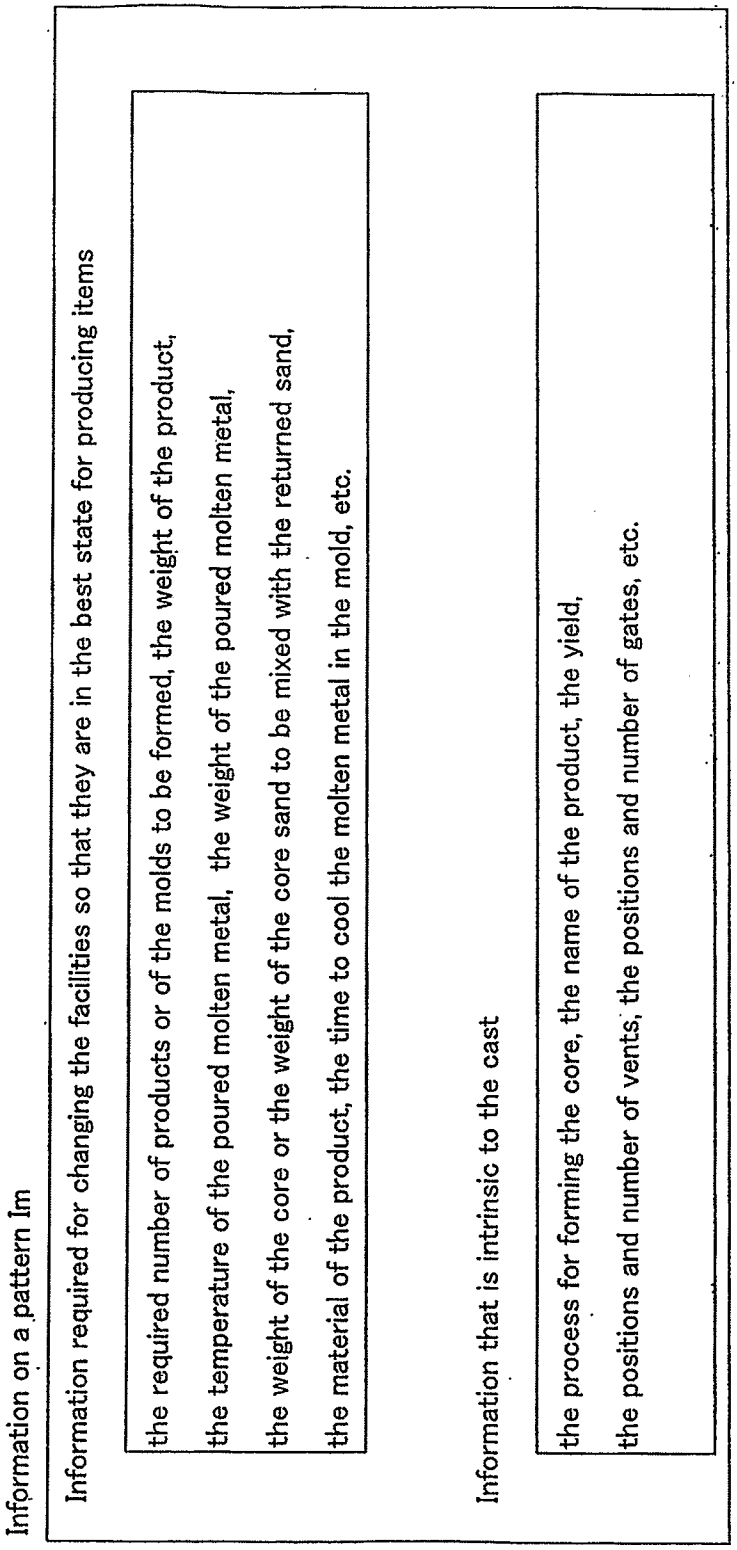
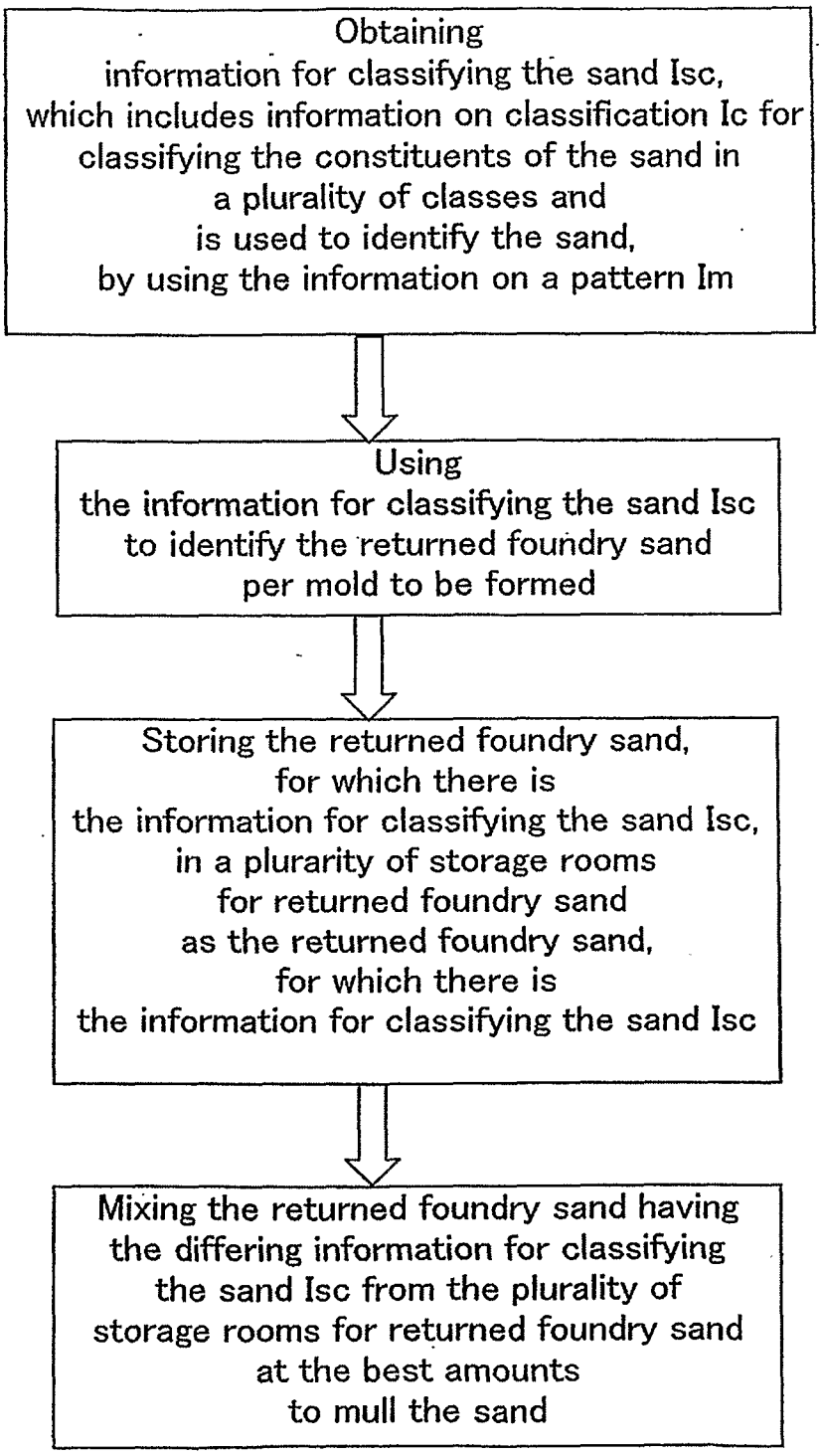

Information on a pattern Im
Information required for changing the facilities so that they are in the best state for producing items
the required number of products or of the molds to be formed, the weight of the product,
the temperature of the poured molten metal, the weight of the poured molten metal,
the weight of the core or the weight of the core sand to be mixed with the returned sand,
the material of the product, the time to cool the molten metal in the mold, etc.
Information that is intrinsic to the cast
the process for forming the core, the name of the product, the yield,
the positions and number of vents, the positions and number of gates, etc.

Fig.7


Obtaining
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is used to identify the sand,
by using the information on a pattern Im
Using
the information for classifying the sand Isc
to identify the returned foundry sand
per mold to be formed
Storing the returned foundry sand,
for which there is
the information for classifying the sand Isc,
in a plurarity of storage rooms
for returned foundry sand
as the returned foundry sand,
for which there is
the information for classifying the sand Isc
Mixing the returned foundry sand having
the differing information for classifying
the sand Isc from the plurality of
storage rooms for returned foundry sand
at the best amounts
to mull the sand

Fig.8

| | Weight of core: Heavy | Weight of core: Middle | Weight of core: Light |
|---|---|---|---|
| Weight of poured metal: Heavy | SA or SB | SB | SB |
| Weight of poured metal: Middle | SA | SD | SD |
| Weight of poured metal: Light | SA | SD | SC |

Fig.9