Feb. 24, 1970 L. J. LE BLANC ET AL 3,496,988

PROCESS OF MAKING GREEN SAND CORES

Filed March 14, 1968 2 Sheets-Sheet 1

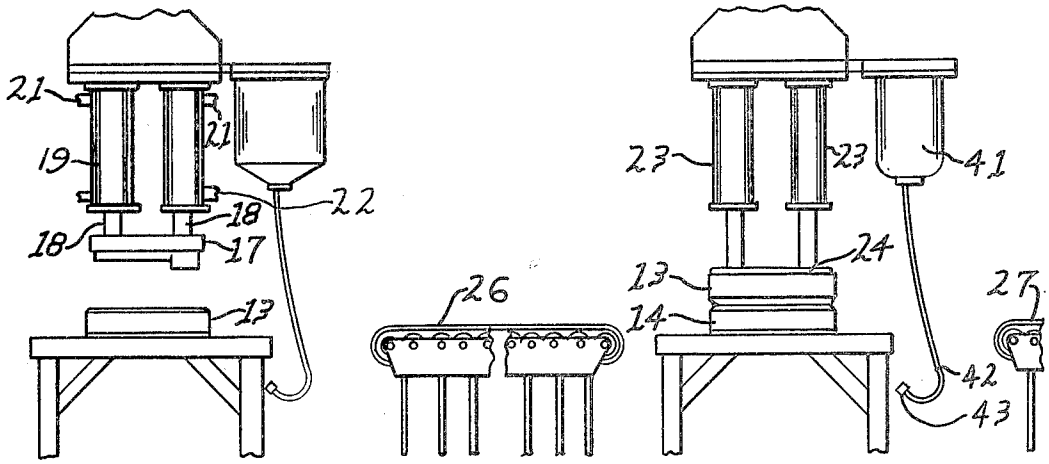


FIG 1

FIG 2

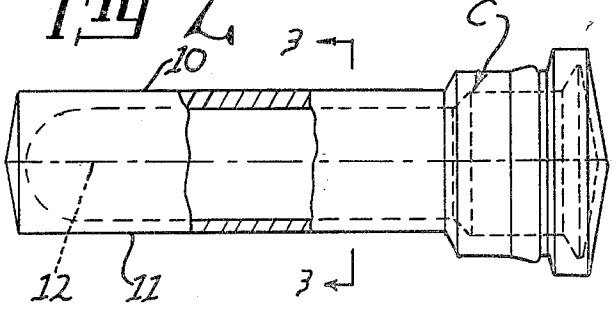
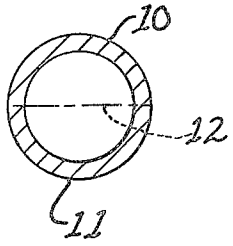


FIG 3



INVENTOR.
LEO J. LEBLANC
GANES T. WORTHY
BY
Jennings Carter & Longson
Attorneys

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PROCESS OF MAKING GREEN SAND CORES

Filed March 14, 1968 2 Sheets-Sheet 2

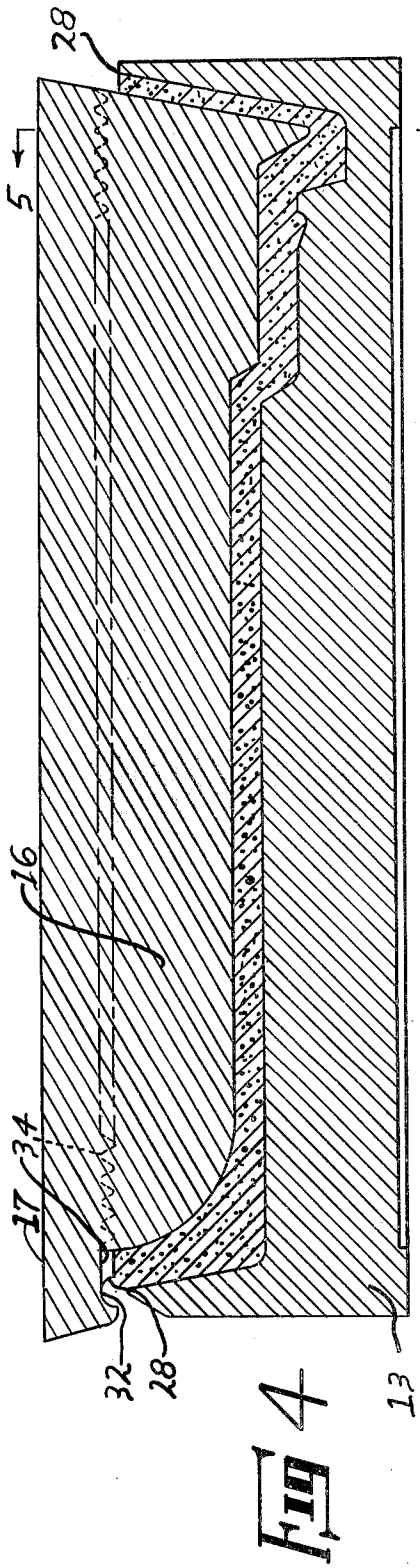

Fig 4

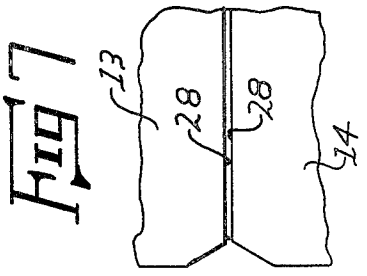

Fig 7

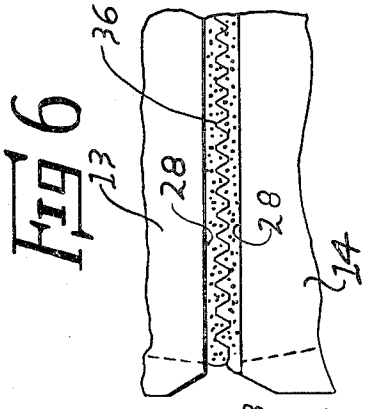

Fig 6

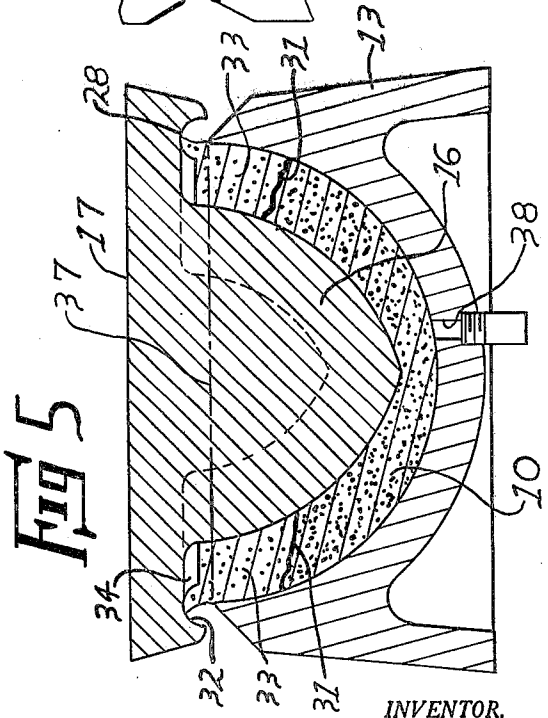

Fig 5

INVENTOR.
LEO J. LE BLANC
GANES T. WORTHY
BY
Jenning Carter & Thompson
ATTORNEYS

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PROCESS OF MAKING GREEN SAND CORES

Leo J. Le Blanc, Birmingham, and Ganes T. Worthy, Anniston, Ala., assignors to Woodward Corporation, a corporation of Delaware

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U.S. Cl. 164—23 8 Claims

ABSTRACT OF THE DISCLOSURE

A process of forming a hollow sand core for use in the foundry arts in which the core in formed in one or more parts and then, by the application of simple pressure on the parts, is adhered together sufficiently to secure the parts together to form the complete core. The parts of the core, for instance, halves, are formed by freely compacting the major body portions of the parts of the core while portions thereof around the edges which are to be mated are compacted to a different degree, usually less than the body portions. Subsequently, the edges are brought together under compaction and thus the parts are adhered.

Our invention relates to sand cores, and to a process for making the same.

In this art it has long been desired to use foundry sand such as green sand in the formation of hollow cores. It has long been recognized that were this possible the use of binders, such as resins and the complicated machinery for forming thermo-setting resin containing cores could be eliminated. However, insofar as we are aware no one heretobefore has solved the problem because of the inherent difficulty of forming a hollow core and yet compacting or hardening the same to the degree required to serve and act as a core. In the past, attempts have been made to form such cores by internal compressing means such as expandable innertube-like members placed inside the core box which, when inflated, were supposed to press the sand against the box, thus to form the hollow core. Other attempts have been made to provide partial green sand cores, as for instance by providing one half of the core of baked sand and the other half of green sand. Further, attempts have been made to fabricate hollow green sand cores by blowing the sand around vented arbors.

An object of our invention is to provide a process for making green sand cores of ordinary silica foundry sand, containing an average amount of clay and moisture, which sand, in the ordinary way after the core is used, may be reconditioned for subsequent use.

More specifically, an object of our invention is to provide a process of producing a hollow green sand core which comprises forming the core in halves, the halves being compacted to the necessary or required degree throughout the major body portions thereof, while the peripheral portions which are to be mated with a like half are left relatively uncompacted, and then, bringing the relatively uncompacted peripheral areas together and subjecting the parts thus brought together to pressure which finishes the compaction in the uncompacted areas and at the same time bonds these areas together, thereby bonding the halves together to form the complete, usable core.

Another object of our invention is to provide a process of the character designated in which the peripheral, relatively uncompacted areas of the core parts are increased as by making the same serrated, whereby when the parts are mated and the parts subsequently pressed together, a more efficient bonding and more efficient compaction is obtained in the relatively uncompacted areas.

Another object of our invention is to provide a process

for making sand cores in which the parts, preferably halves, are formed with the peripheral portions to be mated extending generally above the transverse center line of the core body, whereby when the areas are mated and pressed together the excess volume of sand in the peripheral areas affords opportunity for ample bonding and compaction by a simple pressing of the halves together while in their core boxes.

A further object is to provide a green sand core formed of parts made as heretofore indicated and, to provide a core half or body part possessing the characteristics of being fully compacted throughout most of its body area while remaining relatively uncompacted in its peripheral areas, capable of being mated with a like part to form the complete core.

Apparatus which is suitable for carrying out our improved process is illustrated in the accompanying drawings forming a part of this application in which:

FIG. 1 is a wholly diagrammatic view illustrating apparatus which may be used for forming the core halves and for assembling the complete core body;

FIG. 2 is a view of a completed core;

FIG. 3 is a detail sectional view taken generally along line 3—3 of FIG. 2;

FIG. 4 is a longitudinal sectional view through a core box which has the pattern in place therein showing the sand in the core box, substantially compressed, in order to form the core half;

FIG. 5 is a detail sectional view taken generally along line 5—5 of FIG. 4;

FIG. 6 is a fragmental side elevational view of a portion of two of the core boxes with the halves of the core therein just having been mated and ready to be finally pressed together; and,

FIG. 7 is a view similar to FIG. 6 and showing the core boxes pressed substantially together, resulting in bonding of the core halves.

Referring now to the drawings for a better understanding of our invention it will be understood that we propose a process in which the hollow core indicated generally by the letter C in FIG. 2 is formed of two halves **10** and **11**, joined together as will be explained, along the transverse part line **12**.

In forming the halves we use core boxes **13** and **14** and mandrels **16** which may be mounted on base plates **17**. In FIG. 1 we show in wholly diagrammatic manner one of the mandrels **16** on its base plate **17** mounted on the piston rods **18** of a pair of fluid pressure cylinders **19**. It will be understood that fluid under pressure from a source not shown may be admitted to the upper connections **21** of the cylinders whereby the plate **17** and the mandrel **16** move downwardly into the core box **13**. Similarly, the parts may be raised to the position shown in the lefthand side of FIG. 1 by admitting pressure to the connections **22** while exhausting it from the connections **21**.

It will be understood, as will later appear, that the other half of the core, for instance the half **11**, is to be formed in the core box **14** by means of apparatus like that illustrated at the lefthand side of FIG. 1 and that subsequently the two core parts still in their boxes **13** and **14**, are to be mated and finally pressed together as illustrated in the righthand portion of FIG. 1. Thus, we show fluid pressure cylinders **23** having a presser plate **24** disposed to press down upon the inverted core box **13** and to press it, with its core half therein, against the core half in the box **14**. Conveyors **26** serve to deliver the core box **13** to the assembly station, whereas a conveyor **27** serves to deliver the core boxes **14** to the assembly station, it being understood that the core box **14** is filled, similarly to the one already described in connection with **13**, at a station to the right of the conveyor **27**, not shown.

Referring now to FIGS. 4 to 7 inclusive the first step in forming one half of our improved core is to pile into the box **13** or **14**, as the case may be, a greater quantity of sand than will be required to form the core half. That is, the box is filled above the top **28** thereof. With this accomplished the next step is to bring the mandrel, forcefully by means of the cylinders **19**, down into the sand, whereupon the parts assume the position shown in FIG. 5 thus to shape and form the core half **10**. In the position of the parts shown in FIGS. 4 and 5 it will be understood that the sand in the major body portion of the core half is fully compacted, substantially all the way around and approximately to the lines indicated at **31**. In the areas **33** above the lines **31** the sand is relatively uncompacted inasmuch as the parts are so disposed and the stroke of the piston rods **18** of the cylinders **19** and the applied pressure are such that the peripheral edges of the plate **17**, which are undercut as indicated at **32**, never contact the upper surfaces **28** of the core box **13** or **14**, as the case may be. Thus, any excess sand originally placed in the core box spills out over the edges or periphery of the core box during the downward movement of the mandrel **16**, due to the clearance at **32**. It will be noted that this overhanging portion of the plate **17** is provided along the sides and at one end of the core box. Therefore, throughout the major body portions of the core halves the sand is fully compacted and in the sections indicated generally by the numerals **33**, that is, along the periphery of the core, the sand is relatively uncompacted.

In order to increase the area of contact along the peripheral edges of the core halves we may provide the periphery of the plate **17** with teeth or serrations indicated by the numeral **34**. It will be noted that the serrations or teeth **34**, both at the sides and along the end where they are placed, do not extend outwardly enough to overlie the top **28** of the core box **13** or **14**. This affords ample clearance for the excess sand to be forced out of the core box during the downward movement of the mandrel **16**. However, the result of such teeth is to leave on each core half projecting, serrated, teeth-line sand configurations indicated at **36**.

It will be understood that the mandrel for making the halves are so constructed that when the core boxes containing the halves are inverted as shown in the righthand portion of FIG. 1, the sand teeth match as shown in FIG. 6. It will be further noted that the teeth on the halves of the core lie above the geometrical center line indicated by the line **37**. Also, when forming symmetrical cores the teeth lie above the eventual part line or line of joinder of the parts indicated by the line **12**. Therefore, when the halves are mated for final compaction as indicated in FIG. 6 the amount of compaction left to be accomplished is the space represented between the peripheral edges **28** of the core boxes. Thus, starting with the mated halves as shown in FIG. 6 the core boxes **13** and **14** are simply pressed together until their edges **28** substantially contact as shown in FIG. 7, thus completing the operation and effectively joining the core halves to form the complete core C.

In carrying out our invention and when forming cores of green sand we use silica sand containing about ten to fifteen percent clay and about three to five percent of moisture, both by weight. Such sand has a green compressive strength of from about eighteen to about twenty-five. The mandrel **16**, being pressed into the mold box which has been substantially filled with such sand produces a hardness of about eighty-five to ninety-five in the body areas of the core halves between the lines **31** as shown in FIG. 5. In the contacting areas **33** we estimate that the hardness may be on the order of fifty or less. Thus, when the halves are mated as shown in FIG. 6 and compacted fully as shown in FIG. 7 the volume of sand in the areas **33** is compacted, we believe, to somewhere in the range of eighty to ninety on the standard mold hardness tester.

In the drawings we show a core box half **13** for making one-half of a core which is to be used to pour a fitting for cast iron pipe. However, it will be readily apparent that the configuration of the core box **13** may be varied and that the configuration of the mandrel **16** may likewise be varied to form any desired shape. However, and as stated, in order to bond the halves together to a degree to make the entire core satisfactory for pouring purposes the upper peripheral edges must be compacted to a less degree than the main body of the halves so that when mated and further compacted, bonding and adherence takes place around the periphery.

In order to remove the completed core from the mold halves each of the boxes **13** and **14** may be provided with air passages **38**. At the righthand station shown in FIG. 1 we may provide an air pressure tank **41** with a flexible hose **42** and a nozzle **43**. After final compaction and formation of the core C, air may be supplied to either of the passages, or to both, thus to loosen the completed core for removal. In carrying out this operation it will be understood that the pressure plate **24** is raised and that air under fairly low pressure is admitted through the openings **38**, this having the effect of loosening the halves, permitting them to strip from the core boxes **13** and **14**, whereby the core may be handled in the ordinary foundry process. Also, and as is customary, we prefer to dust or spray the inner surfaces of the core boxes **13** and **14** prior to packing the sand therein.

In view of the foregoing it will be apparent that we have devised an improved process and an improved hollow foundry core of uniform wall thickness. To those skilled in the foundry art the importance of providing a hollow core will be readily apparent. Among other advantages it should be pointed out that the provision of the hollow core permits occluded gases in the iron or other metal being poured to vent themselves into the inside of the core during the pouring operation, thus resulting in sounder castings. It will be further understood that the core is supported on a print in the mold to be poured. Further, the thickness of the walls of the core can be varied to suit the particular circumstance encountered in the production of the finished parts to be cast and our invention lends itself to the formation of cores of varied shapes and complexities.

In actual practice we have found that our improved process and core is entirely satisfactory. Furthermore, we have found that it is possible to automate the formation of these cores into a completely automated casting machine which includes the core forming section, the core setter section, the pouring section, and the shake-out section. The advantage of hollow versus solid cores in the shake-out operation is well known. While it is extremely difficult to obtain precise measurements of the degree of compaction of the sand in the areas **33**, particularly in the serrations or teeth **36**, nevertheless we believe, from practical observations and tests that on the surface of the teeth the compaction is about on the order of fifty or less, when measured with a standard hardness tester and when using green sand. Of course, as the measurements are taken from the very top of the half of the core downwardly, the hardness increases until finally, somewhere downwardly of the lines **31** the body is almost fully compacted upto about eighty-five to ninety-five hardness. At all events, we have found that cores formed by our improved process from green sand are strong enough to be handled in the ordinary course of using them in the foundry arts, are fully capable of being poured upon to form sound castings and still are frangible enough to be easily broken up by shaking to remove them from the finished parts.

While we have laid particular stress herein on forming cores of green sand it will be understood that our invention has utility in producing cores made of sand containing chemicals which react to heat, gases or the like to cure the cores. In such cases the steps herein set forth for

forming the core parts are carried out using the desired materials. After assembling the halves and while they are still in their boxes the core may be hardened by gassing, heating, etc. Thus, our invention has utility in making hollow cores, whether or not green sand is used and this is true because once partially packed and then brought together, the parts of our improved core may be hardened or cured by means other than compaction alone. However, as will be appreciated the formation of usable, hollow cores of green sand by our process has unlimited uses in the art.

While we have shown our invention in but one form, it will be obvious to those skilled in the art that it is not so limited, but is susceptible of various other changes and modifications without departing from the spirit thereof, and we desire, therefore, that only such limitations shall be placed thereupon as are specifically set forth in the appended claims.

What we claim is:

1. The process of producing sand cores which comprises:
   (a) forming at least two complementary portions of the core adapted to be adhered together along contacting surface areas thereof,
   (b) compacting the sand of each part in those areas to be adhered to a lower density than the density of the remainder of each core part,
   (c) mating the parts by bringing said lower density contacting areas together, and
   (d) compacting the sand in the areas of said contacting surfaces to a degree to form a complete core.

2. The process of producing sand cores which comprises:
   (a) forming at least two separate, complementary core bodies adapted to be mated in certain areas thereof to form a complete core,
   (b) compacting the sand throughout each of said bodies except in said areas to be mated to a degree for the bodies to be usable as cores and in said areas to a degree less than the remainder of the bodies but to a degree sufficient for the parts to be handled for mating, and
   (c) mating the bodies by bringing together said areas and thereafter subjecting the mated bodies to compacting pressure in said areas of a magnitude sufficient to cause cohesion of the core bodies in said areas.

3. The process of producing hollow green sand cores which comprises:
   (a) forming the core body in halves, each half being partially hollow so that when the halves are put together the resulting core is hollow,
   (b) compacting the sand in the major portion of said body halves to a degree to make the same usable as a core,
   (c) leaving substantially uncompacted areas around the periphery of each half which are to be placed in contact with similar areas of the other half,
   (d) mating the cores in the substantially uncompacted areas thereof, and
   (e) completing the formation of the core by pressing the halves together, thereby to adhere the halves together in the uncompacted areas thereof.

4. The process of producing cores of moldable material which comprises:
   (a) placing in a mold a quantity of loose core forming material in an amount greater than the amount required to form a part of the complete core,
   (b) compacting the material in the mold in the major body areas of the core part while leaving peripheral areas thereof substantially uncompacted and extending above the parting line of the core box,
   (c) repeating the steps set forth in (a) and (b) above, thereby to provide a second core part disposed to be mated in said peripheral areas with the first core part,
   (d) mating the core parts in said peripheral areas, and
   (e) subjecting the mated core parts to pressure in said peripheral areas of a magnitude sufficient to bring the parting lines of the core boxes substantially together, thereby compacting and adhering the sand in said peripheral, mating areas.

5. The process of claim 4 which includes the step of hollowing out each core part during the formation thereof, whereby when joined as stated the core body is hollow.

6. The process of claim 4 in which the core parts, in said peripheral areas to be mated, are formed with serrations or the like which increase the area of contact of the contacting surfaces of said areas.

7. The process of claim 4 which includes the steps of forming on the surfaces of said peripheral areas a series of serrations so spaced and configured as to interfit with like serrations on the other core part when the parts are mated.

8. In a process of forming a part of a green sand core adapted to be mated with a like part comprising:
   (a) filling a core box with green sand in an amount in excess of that required to form the part,
   (b) packing the sand in said core box by forcing a mandrel into the central portion of the excessively filled core box,
   (c) permitting sand in excess of that required to form the part to spill out over the periphery of the core box during the packing step, and
   (d) leaving the sand in peripheral areas of the part relatively uncompacted, whereby there is provided a core part adapted to be adhered to a similar part by mating the parts and pressing them together in said relatively uncompacted peripheral areas.

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J. SPENCER OVERHOLSER, Primary Examiner

JOHN E. ROETHEL, Assistant Examiner

U.S. Cl. X.R.

164—37, 228, 369