June 11, 1929. D. J. RYAN 1,717,325

METHOD OF AND MEANS FOR MAKING REENFORCED CORES OF MOLDS

Filed April 17, 1925 4 Sheets-Sheet 1

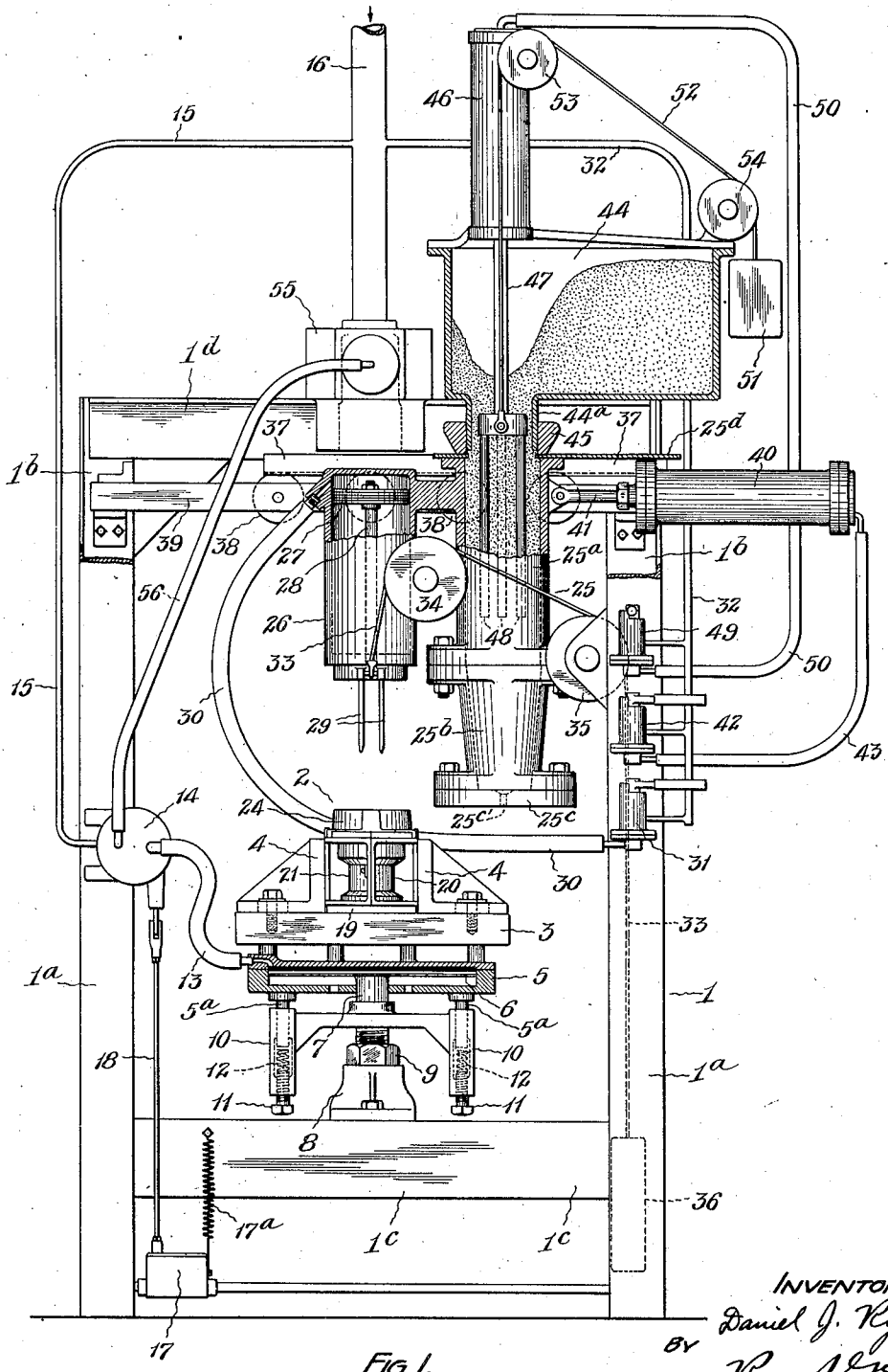


FIG. 1.

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METHOD OF AND MEANS FOR MAKING REENFORCED CORES OF MOLDS

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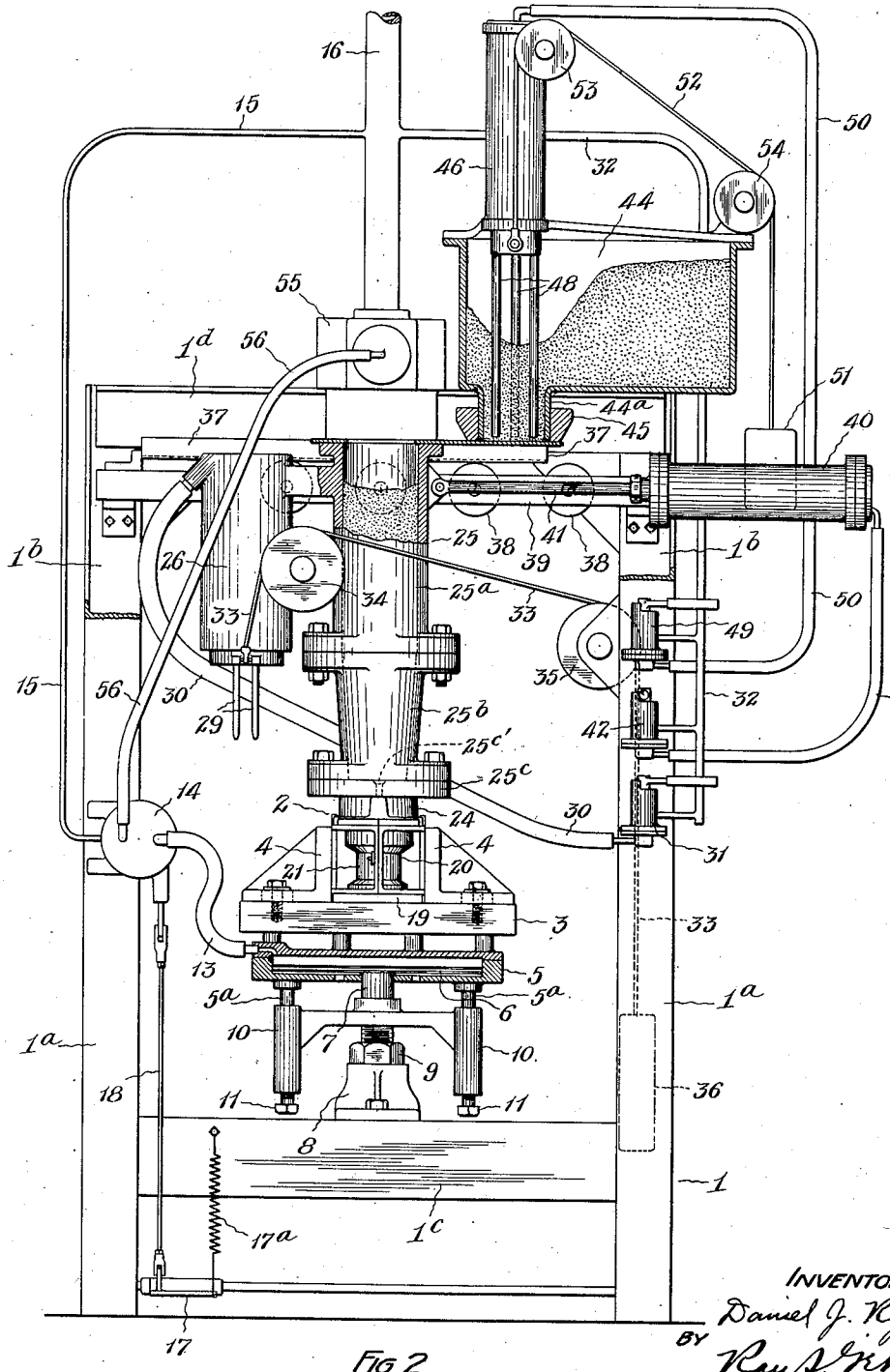


FIG. 2.

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METHOD OF AND MEANS FOR MAKING REENFORCED CORES OF MOLDS

Filed April 17, 1925 4 Sheets-Sheet 3

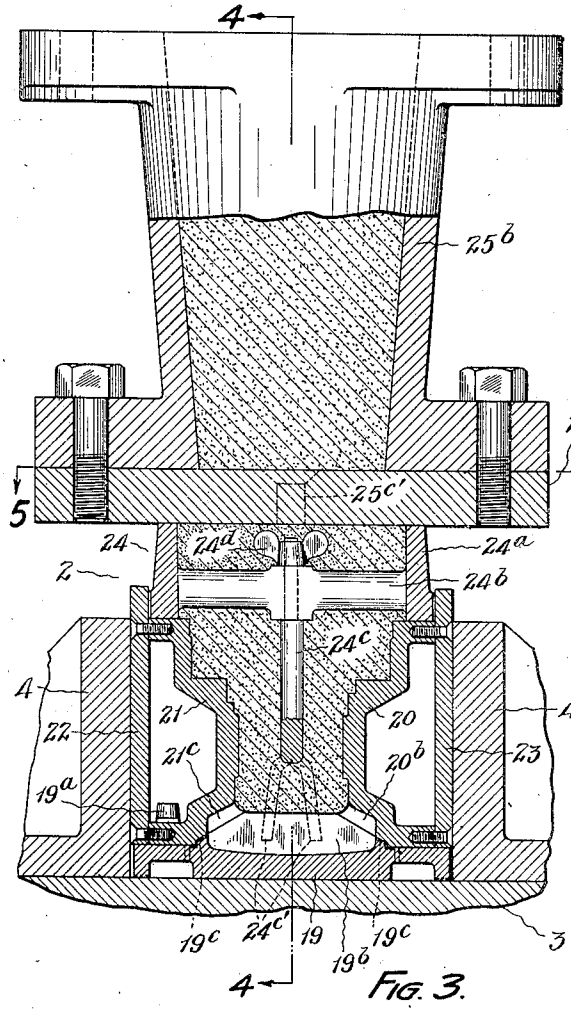


FIG. 3.

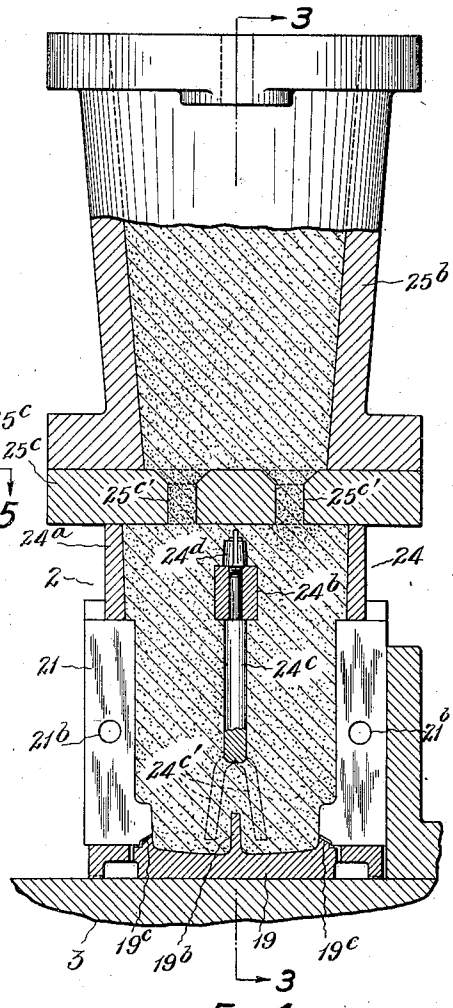


FIG. 4.

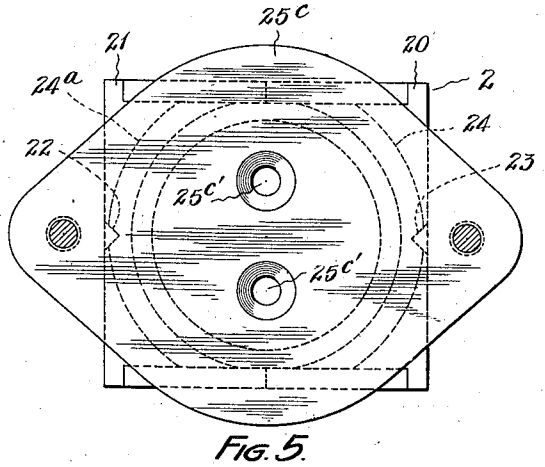


FIG. 5.

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METHOD OF AND MEANS FOR MAKING REENFORCED CORES OF MOLDS

Filed April 17, 1925 4 Sheets-Sheet 4

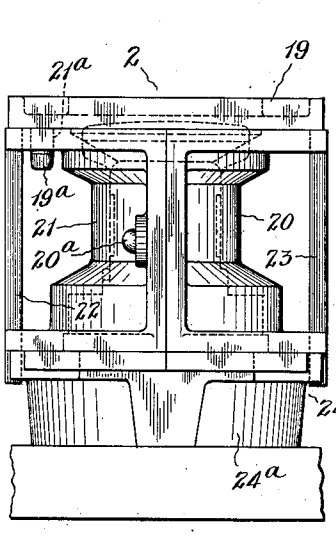


FIG. 6.

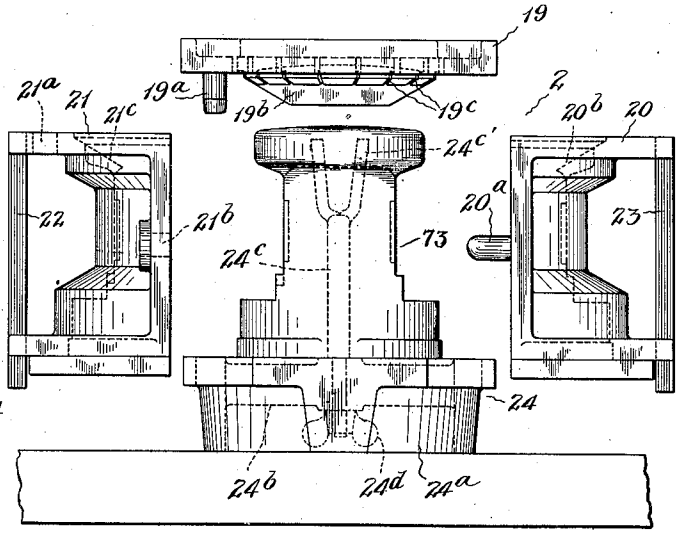


FIG. 7.

INVENTOR:
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Patented June 11, 1929. 1,717,325

UNITED STATES PATENT OFFICE.

DANIEL J. RYAN, OF CLEVELAND, OHIO, ASSIGNOR TO THE CLEVELAND TRUST COMPANY, OF CLEVELAND, OHIO, A CORPORATION OF OHIO.

METHOD OF AND MEANS FOR MAKING REENFORCED CORES OF MOLDS.

Application filed April 17, 1925. Serial No. 23,812.

The invention relates to an improved method and apparatus for the production of reenforced sand cores suitable for use in semi-permanent molds, the invention being especially applicable to the production of cores for use in metallic molds suitable for the production of cup-shaped castings, such as engine pistons, formed of aluminum alloys or other light-weight metals.

One of the principal objects of the present invention is to provide a rapid and economic method of making sand cores, and particularly green sand cores, of uniformly high quality having metallic reenforcements and adapted for use in semi-permanent molds.

Another object of the invention is the provision of improved apparatus adapted to carry out the core forming method last referred to.

Other objects more or less incidental or ancillary to the foregoing and the manner of attaining all of the various objects will appear in the following description.

In carrying out my invention I provide a core box with an open topped cavity and suitably constructed to permit removal of the core when formed. I also provide a metallic core-reenforcing structure comprising a core print or arbor portion designed to engage the core box near the top of its core cavity and another portion rigidly connected to the core print portion and adapted to be embedded within the sand body of the core when formed. The core print portion is provided with one or more openings through which sand can be introduced into the cavity of the core box and compacted upon the metal reenforcing structure. I also provide a sand container having one or more discharge openings adapted to register with the opening or openings in the core print and also adapted to receive compressed air above the body of sand in it. I also preferably provide means for compacting the sand in the sand container before the compressed air is admitted above the sand. With apparatus of this character provided I assemble the core box with the core-reenforcing structure mounted in it as above described. Then sand of a suitable character is introduced into the sand container. I prefer to use fine grained sand moistened with water, such as is commonly referred to as green molding sand. The sand in the container having been compacted in any suitable manner, as by jarring or ramming, so as to obviate any voids in the container, I effect a substantially sand tight connection between the core box and the said container with the interior of the latter in communication with the cavity of the core box through the discharge opening or openings of the container and the opening or openings through the core print, and this is preferably accomplished by pressing the core box and container together so as to tightly clamp the core print between them, thereby at the same time holding the core print in fixed predetermined relation to the core box cavity. Then the air space above the sand in the container having been suitably connected with a source of compressed air the latter is admitted to the top of the sand and its pressure forces sand through the discharge opening or openings of the container into the core box so as to fill the same and form a sand core with a metallic reenforcing structure of the character above described. To insure a complete filling of the core box cavity I prefer to vent any air that may be trapped in the lower part of the cavity, as the sand enters, through suitable small vent passages in the wall of the lower part of the core box. The core having been formed in the manner described the connection between the sand container and the core box is separated and the core is removed from the core box, the latter being made in sections, of course, if the core is of a character to require it.

The core thus produced is adapted to be lowered into the open top cavity of a suitably constructed metal mold body formed to provide a seat for the metal core print and means for accurately locating the core in the cavity of the mold.

With suitable core-forming apparatus such as has been referred to, cores of high quality can be made by my improved method with very great rapidity and at a low cost. I find that the fine green sand can be blown by my method so as to produce cores of highly uniform hardness and, with suitable metallic reenforcing structure, the cores have adequate strength for handling and use in semi-permanent molds and the use of the reenforcing structure in conjunction with an accurately formed core box produces cores of sufficiently

uniform dimensions to insure the production of highly accurate castings when the cores are mounted in metal molds.

In the accompanying drawings I have shown the preferred form of apparatus for the practice of my invention and in what follows I will first describe the apparatus and then point out the manner in which it is utilized in carrying out the method.

In the drawings, Fig. 1 is a front elevation of the assembled apparatus with some of the parts shown in section and with the sand container in position to be filled, the showing of some parts of the apparatus being more or less diagrammatic in character.

Fig. 2 is a front elevation of the apparatus with the sand container moved to register with the core box and with the source of compressed air.

Fig. 3 is an enlarged vertical section through the core box and some of the adjacent parts of the apparatus as shown in Fig. 2.

Fig. 4 is a vertical section on the line 4, 4 of Fig. 3.

Fig. 5 is a section on line 5, 5, of Fig. 3.

Fig. 6 is an enlarged front elevation of the core box inverted and resting on a suitable base or support preliminary to the separation of the core box to free the core.

Fig. 7 is an enlarged front elevation showing the finished core and the three sections of the core box separated therefrom.

Referring in detail to the construction illustrated, 1 designates the supporting frame of the core-forming apparatus which is shown as made of structural steel forms comprising front uprights 1^a, 1^a similar rear uprights 1^b, 1^b, bottom transverse members 1^c, 1^c and similar top transverse members 1^d, 1^d. These structural members are suitably riveted together with strengthening gussets, bars, etc., and need not be described in detail as any suitable supporting frame work for the apparatus can be used.

The core box which is designated in its entirety by 2 is supported upon a bed plate 3 upon which is adjustably mounted a pair of guides 4, 4 adapted to engage the side of the core box and hold it securely in position. The bed or support 3 is mounted upon a cylinder 5 in which is mounted a piston 6 that has a rod 7 that is threaded at its lower end and adjustably mounted in the aperture of a supporting casting 8 that is in turn mounted upon the frame members 1^c, 1^c. The piston rod 7 is secured in an adjusted position by a lock nut 9. The piston rod has rigidly secured to it a plurality of vertical guides 10, 10 in which are slidably mounted depending rods 5^a, 5^a carried by the cylinder 5. Screws 11, 11 are adjustably mounted in the lower ends of the guides 10 and serve to adjustably support buffer springs 12, 12 which thus constitute yieldable stops to limit the downward movement of the cylinder 5. The cylinder space above the piston 6 communicates through a suitable port and a hose 13 with an air valve 14 which communicates through a pipe 15 with a suitable compressed air supply pipe 16. The valve 14 is actuated by a foot lever 17 through a connecting link 18. The lever 17 being fitted with a retracting spring 17^a.

The core box 2 in the present instance is designed to form the core of a semi-permanent mold for casting skirted aluminum alloy pistons such as are commonly employed in internal combustion engines. The core box comprises a base plate 19 and side members 20, 21. Referring to Fig. 7 which shows the parts of the core box inverted it will be observed that the base 19 is fitted with a dowel pin 19^a adapted to engage a hole 21^a in side member 21. Similarly the side member 20 is fitted with a dowel pin 20^a designed to engage a hole 21^b in the side member 21. As is best shown in Figs. 3 and 4 the base and side members of the core box are formed with ribs 19^b, 20^b and 21^c so as to form a corresponding recess in the core which in turn forms a corresponding rib on the under side of the head of the piston casting that is to be produced. As clearly shown in Figs. 3, 4 and 7 the base plate 19 is formed with a series of minute grooves and apertures 19^c, 19^c which form vent passages adapted to conduct air from the lower part of the core box through the walls of the same to the atmosphere. The side members 20 and 21 of the core box carry upright triangular shaped guide rods 22 and 23 which serve to accurately locate the core reenforcing structure relative to the cavity of the core box.

The core reenforcing structure last referred to is designated in its entirety by 24 and comprises a circular and preferably annular core print section 24^a which is formed with a transverse bar 24^b having a central hub in which is secured a depending reenforcing rod 24^c, the reduced upper end of said rod being threaded to receive a securing wing nut 24^d. The lower end of the rod 24^c is preferably quartered by splitting it longitudinally and the resulting fingers $24^{c'}$ are spread apart as indicated in Figs. 3 and 4 to form anchors which effectively support and reenforce the lower part of the core.

Above the core box is arranged a movably mounted sand container and vent-forming unit. The sand container 25 comprises a cylindrical section 25^a to the lower end of which is secured a slightly tapering section 25^b fitted with a bottom plate 25^c which has sand discharge apertures $25^{c'}$, $25^{c'}$. A compressed air cylinder 26 which is rigidly secured to the sand container 25 has a piston 27 mounted in it and the depending rod 28 of said piston carries at its lower end a series of depending pins 29 which are designed to be forced downward into the sand

core to form vents therein. Compressed air can be admitted to the upper end of the cylinder 26 through a suitable port and a hose 30 which communicates with a control valve 31 that in turn is connected by pipe 32 with the compressed air supply pipe 16. To the lower end of the piston rod 28 is connected a cord or chain 33 which passes over sheave 34 mounted on the sand container 25 and a sheave 35 mounted on the supporting frame 1, and has connected to its lower depending end a weight 36 adapted to retract the piston 27 when the space above it is open to exhaust by manipulation of the valve 31. The weight 36 is also designed to move the sand container and vent cylinder unit bodily laterally as will presently be explained. The sand container and vent unit is fitted with a pair of supporting rails 37, 37 which run on a plurality of antifriction wheels 38, 38 mounted on bars 39, 39 of the main supporting frame structure. Thus mounted, the sand container and vent cylinder unit can be moved to a limited extent horizontally. To affect such movement in one direction a compressed air cylinder 40 is provided in which is mounted a suitable piston (not shown) having its rod 41 suitably connected as shown to the sand container 25.

Compressed air can be admitted to the outer end of the cylinder through the supply pipe 32, a control valve 42 and a hose 43. When compressed air is admitted to the cylinder 40 the sand container is moved from the position shown in Fig. 1 to that shown in Fig. 2, and when the air space of the cylinder 40 is open to exhaust the weight 36 serves to retract the sand container and vent cylinder unit from the position shown in Fig. 2 to that shown in Fig. 1.

Above the sand container is a sand hopper 44 which has its bottom fitted with a discharge conduit 44^a adapted to register with the upper end of the sand container 25 when the latter is in the position shown in Fig. 1. On the discharge conduit 44^a is slidably mounted a heavy collar 45 which rests upon a cut-off plate 25^d carried by the sand container 25. The collar 45 rides upon the plate 25^d and serves to prevent any material leakage of sand when the sand container is moved from it to the other of its working positions.

On top of the hopper 44 is mounted a compressed air cylinder 46 in which is mounted a piston (not shown) having a rod 47 that carries at its lower end a plurality of ram rods 48 designed to be thrust down through the sand in the hopper and the sand container 25 to compact the sand therein and fill any voids in the sand container. Compressed air is admitted to the cylinder 46 through the supply pipe 32, control valve 49 and hose 50. The ram rods 48 are forced downward by admitting compressed air to the cylinder 46 and are retracted by a weight 51 which is connected by a cord or chain 52 with the piston rod 47, the chain passing over suitable guide sheaves 53, 54.

Above and in vertical alignment with the core box is supported a chambered compressed air head or cap 55. The lower end of the head 55 is open to communicate with the upper open end of the sand container 25 when it is moved to register therewith as shown in Fig. 2. The upper end of the chamber or head 55 communicates through hose 56 with the compressed air control valve 14.

In the use of the above described apparatus for the production of cores I proceed as follows: Assuming that the sand container is in the position shown in Fig. 1 and that the sand hopper 44 is supplied with fine green molding sand, the operator first assembles the core box by placing the side members 20 and 21 in position on the base member 19. He then places the core reenforcing structure 24 in position with the core print part 24^a resting upon the top of the core box and the rod 24^c depending into the core box cavity. The core box with the reenforcing structure is then slipped into position on the bed 3 and between the guide brackets 4, 4 as shown in Fig. 1. The operator then moves the air valve 49 to actuate the ram 48 and thereby insure that the sand which has entered the container 25 from the hopper 44 is free from voids. Next the operator moves the air controlled valve 42 to admit air to the cylinder 40 and move the sand container 25 to the position shown in Fig. 2 with said container registering at its upper end with its compressed air cap 55 and its lower end with the core box 2. Next the operator presses the foot lever 17, the first part of this movement serving to admit air to the cylinder 5 thereby lifting said cylinder and bed 3 and the core box until the upper end of the core print 24 engages the lower side of the plate 25^c of the sand container 25 and then moves said container itself slightly upward until its upper end similarly engages the lower side of the compressed air cap 55. In this manner the interior of the sand container is placed in communication with the core box cavity through the core print and, at the same time, a substantially sand tight connection is effected between the core box and the sand container and the core print is held in fixed predetermined relation to the core box cavity. The further movement of the foot lever 17 and control valve 14 admits compressed air to the cap 55 and to the sand in the upper part of the container 25. The effect of the compressed air upon the sand in the container 25 is to force sand from the lower part of the container through the discharge openings $25^{c'}$ so as to completely fill the core box and the annular core print 25 with sand, said filling operation with suitable air pressure of about 90 pounds per square inch being

exceedingly rapid. Thereupon the operator releases the foot lever 17 and as it is retracted by the spring 17ª the valve 14 is moved to exhaust position, whereupon the weight of the bed 3 and its associated parts and of the sand container 25 and its associated parts cause them to move downward slightly so that the sand container is free to be retracted to the position shown in Fig. 1. By moving the valve 42 to exhaust position such retraction is effected by the weight 36 as previously explained. When the sand container has been retracted to the position shown in Fig. 1 the operator turns the air valve 31 to admit compressed air above the piston 27 thereby forcing the piston downward and causing the vent pins 29 to penetrate the sand of the core and form vent passages therein. As soon as the valve 31 is returned to off or exhaust position the weight 36 serves to retract the piston 27 and the pins 29 to the position shown in Fig. 1.

This completes the formation of the core and the operator now draws the core box from its supporting bed 3 and inverts it on a suitable support as shown in Fig. 6. He then separates the core box from the core by first lifting off the base member 19 and then moving the side members 20 and 21 laterally away from the core as indicated in Fig. 7.

While I prefer in carrying out my process of making the cores to use a coordinated apparatus of the character of that above described, it will readily be understood that some at least of the steps of the process can be carried out with the use of simple manual devices. For example the core when formed can be vented by the use of a manual vent pin in the well known manner. Again the operator can use a hand bar to ram the sand down in the sand container 25. And obviously suitable connection can be made between the sand container and the core box and between the sand container and the compressed air head otherwise than by forcing the parts together with a compressed air cylinder and piston. However, it is desirable to use a coordinated apparatus because the filling of the core box with sand by compressed air is effected in remarkably short space of time, a fraction of a second sufficing, and it is desirable to have a well coordinated apparatus capable of performing the other operations with celerity in order to take proper advantage of the very great speed with which the core box is filled with sand.

Although in the practice of my process the core box is filled very quickly indeed I find that the action is highly uniform. That is to say the core box is always completely filled and the sand body of the core is of uniform hardness. In practicing the process it is highly desirable to form a substantially sand tight connection between the core box cavity and the sand container because if any opening is left between the core box and the sand container the escape of sand through the opening may be sufficient to prevent the complete uniform filling of the core box above referred to.

I consider it highly desirable and essential to provide the lower part of the core box cavity with vent openings so that any air trapped by the entering sand can freely escape from the lower part of the core box cavity. If such vents are not provided air trapped by the entering sand is very likely to form voids or soft spots in the core.

Reenforced green sand cores produced in the manner above described can be employed in metal mold bodies of various forms of construction. The metal mold body does not in itself constitute a part of the present invention, but reference may be had to my U. S. Patent No. 1,659,837 and to my pending application Serial No. 23,813, filed April 17, 1925, (United States Patent No. 1,684,715) for disclosures of molds in which such cores are used.

Reenforced green sand cores formed by my improved process have adequate strength for the necessary handling in the making of castings, they are accurate in form and dimensions, and by reason of the metallic core print feature can be accurately located and suspended in the cavity of a permanent mold. The cores made in accordance with the present process have the added advantage of great uniformity in solidity because the core box can be filled more uniformly by the action of compressed air than it can be filled by hand.

As has been intimated above, cores can be formed by my improved blowing process with very great rapidity particularly when suitable apparatus is employed. This results in a very material reduction in the cost of producing such cores as compared with the manual method of filling the core box previously devised by me.

While I prefer to practice my invention in the manner which has been described and indicated in the drawings it is to be understood that there can be various modifications in the process and the apparatus employed without departing from the invention as defined in the appended claims.

What I claim is:

1. The improved process of forming the cores of molds for cup-shape piston castings which cores have a body of green sand and a metallic reenforcing structure comprising a core print portion and an embedded portion rigid with the core print portion, said process comprising positioning the metallic reenforcing structure of the core in the open-topped cavity of a core box with the core print portion engaging the top part of the core box and sustaining the said reenforcing structure in predetermined position in relation

to the core box cavity; placing a container of fine green sand in communication with an opening through said core print portion so as to form a substantially sand tight closure of the said opening and the said core box cavity except for the communication of the said sand container therewith; forcing sand by means of compressed air from said container through said communication into the core box cavity to fill the same; and removing the core thus formed from the core box.

2. The improved process of forming the cores of molds for cup-shape piston castings which cores have a body of green sand and a metallic reenforcing structure comprising a core print portion and an embedded portion rigid with the core print portion, said process comprising positioning the metallic reenforcing structure of the core in the open-topped cavity of a core box with the core print portion engaging the top part of the core box and sustaining the said reenforcing structure in predetermined position in relation to the core box cavity; placing a container of fine green sand in communication with an opening through said core print portion so as to form a substantially sand tight closure of the said opening and the said core box cavity except for the communication of the said sand container therewith; forcing sand by means of compressed air from said container through said communication into the core box cavity to fill the same and meanwhile venting air from the lower part of the core box cavity through the core box walls; and removing the core thus formed from the core box.

3. The improved process of forming the cores of molds for cup-shape piston castings which cores have a body of green sand and a metallic reenforcing structure comprising a core print portion and an embedded portion rigid with the core print portion, said process comprising positioning the metallic reenforcing structure of the core in the open-topped cavity of a core box with the core print portion engaging the top part of the core box and sustaining the said reenforcing structure in predetermined position in relation to the core box cavity; introducing a mass of fine green sand into a container; mechanically compacting the sand in said container; placing said container in communication with an opening through said core print portion so as to form a substantially sand tight closure of the said opening and of the said core box cavity except for the communication of the said sand container therewith; forcing sand by means of compressed air from said container through said communication into said core box cavity; and removing the core thus formed from the core box.

4. The improved process of forming the cores of molds for cup-shape piston castings which cores have a body of green sand and a metallic reenforcing structure comprising a core print portion and an embedded portion rigid with the core print portion, said process comprising positioning the metallic reenforcing structure of the core in the open-topped cavity of a core box with the core print portion engaging the top part of the core box and sustaining the said reenforcing structure in predetermined position in relation to the core box cavity; placing a container of fine green sand in communication with an opening through said core print portion so as to form a substantially sand tight closure of the said opening and the said core box except for the communication of the sand container therewith; forcing sand by means of compressed air from said container through said communication into the core box cavity to fill the same; forming in the sand body of the core vent passages opening through the upper end of said body; and removing the core thus formed from the core box.

5. In apparatus for making reenforced sand cores having a body of sand and a metallic reenforcing structure comprising an exposed core print portion, the combination of a core box having an open-topped cavity shaped to form the core for a skirted piston casting and formed adjacent the mouth of said cavity to support the core print portion of the core reenforcing structure with a sand tight joint between said box and core print portion; a container for sand; means for effecting a substantially sand tight connection between the core print portion of the reenforcing means and the sand container with the interior of the latter in communication through the core print portion of the reenforcing structure with the core box cavity; means for introducing sand into said container; and means for applying compressed air to the sand in the container to force some of said sand into the core box cavity to fill the same.

6. In apparatus for making reenforced sand cores having a body of sand and a metallic reenforcing structure comprising an exposed core print portion, the combination of a core box having an open-topped cavity shaped to form the core for a skirted piston casting and formed adjacent the mouth of said cavity to support the core print portion of the core reenforcing structure; a container for sand; means for pressing the core box and the sand container together, whereby substantially sand tight joints are formed between the core box and the said core print portion and between the latter and the sand container with the interior of the sand container in communication through the core print portion with the core box cavity; means for introducing sand into said container; and means for applying compressed air to the sand in the container to force some of the

said sand into the core box cavity to fill the same.

7. In apparatus for making reenforced sand cores having a body of sand and a metallic reenforcing structure comprising an exposed core print portion, the combination of a core box having an open-topped cavity shaped to form the core for a skirted piston casting and formed adjacent the mouth of said cavity to support the core print portion of the core reenforcing structure; a container for sand having a bottom discharge passage adapted to register with a passage through said core print portion; means for pressing the core box and sand container together to hold the reenforcing structure in predetermined position in relation to the core box cavity and to maintain communication between the interior of the sand container and the cavity of the core box with a substantially sand tight connection; means for introducing sand into said container; and means for applying compressed air to the sand in the container to force some of the said sand into the core box cavity to fill the same.

In testimony whereof, I hereunto affix my signature.

DANIEL J. RYAN.