Oct. 11, 1966 W. H. L. BRYCE 3,277,538

AUTOMATIC CORE BLOWING MACHINE

Filed July 23, 1964 3 Sheets-Sheet 1

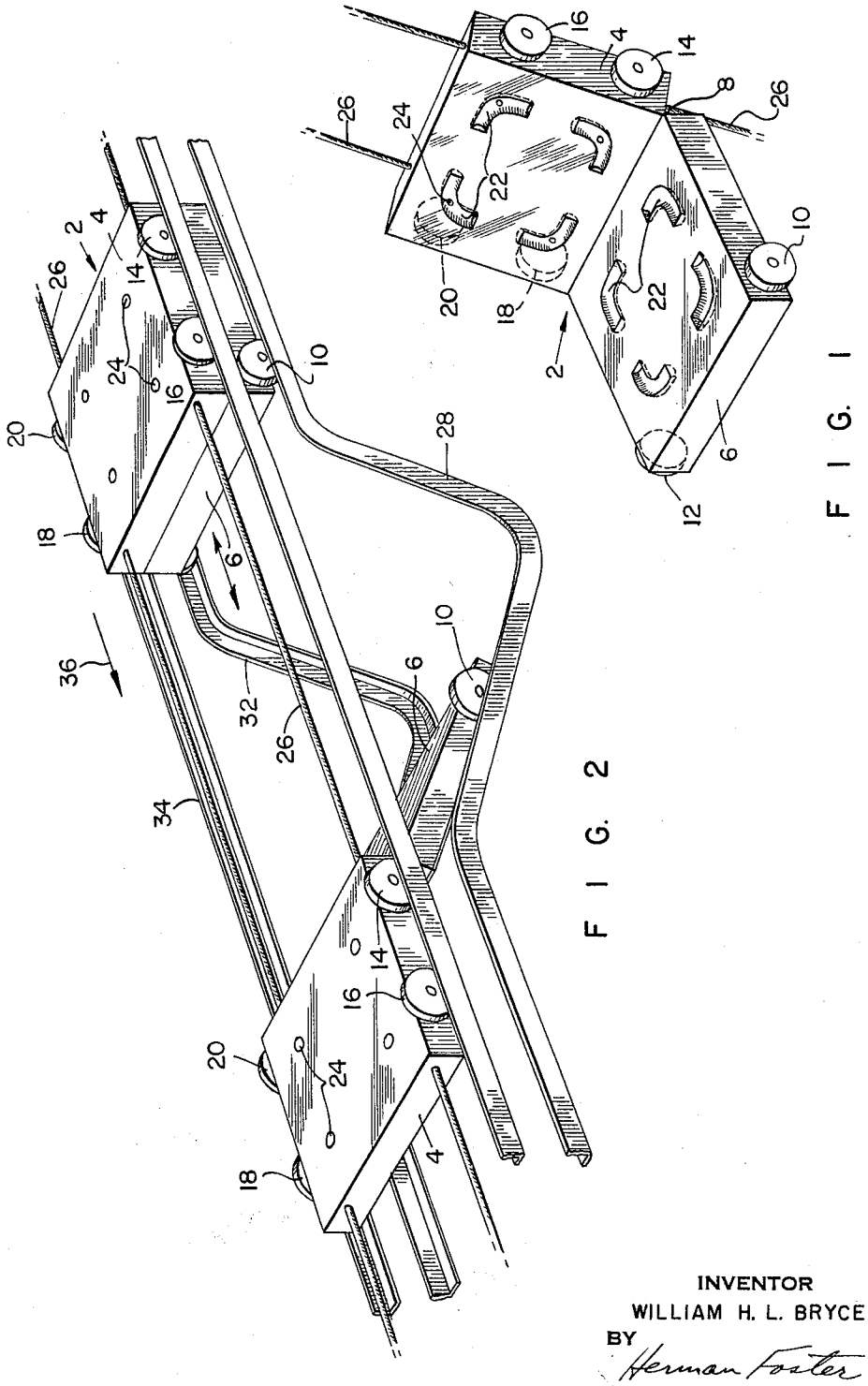


FIG. 1

FIG. 2

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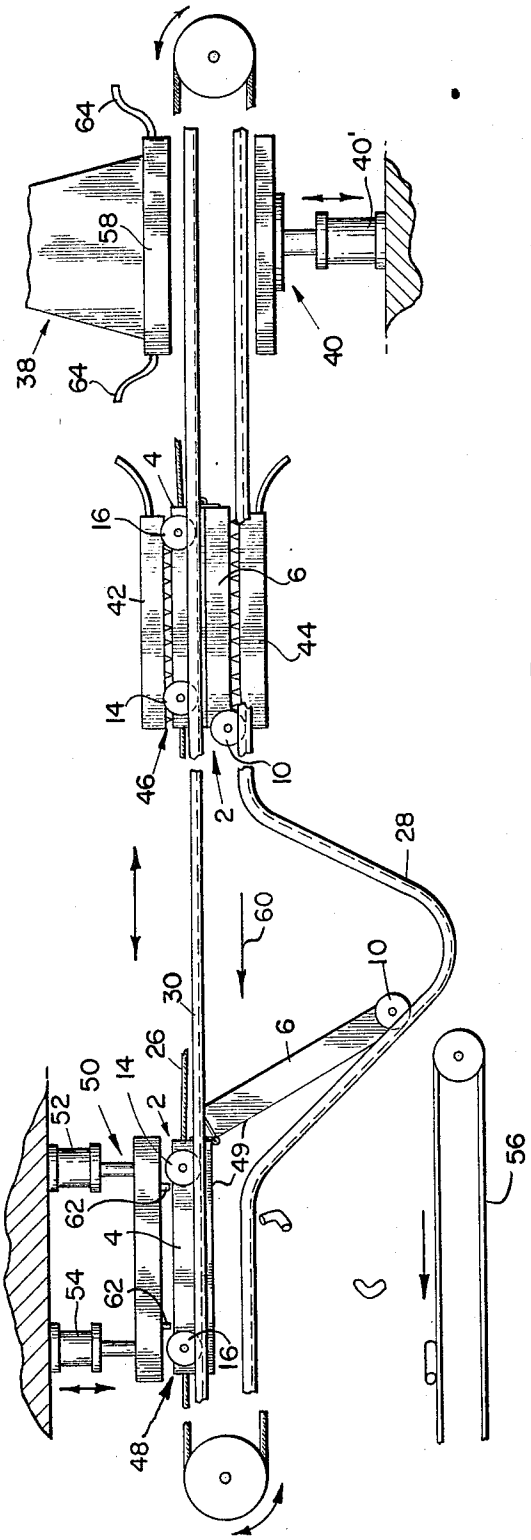


FIG. 3

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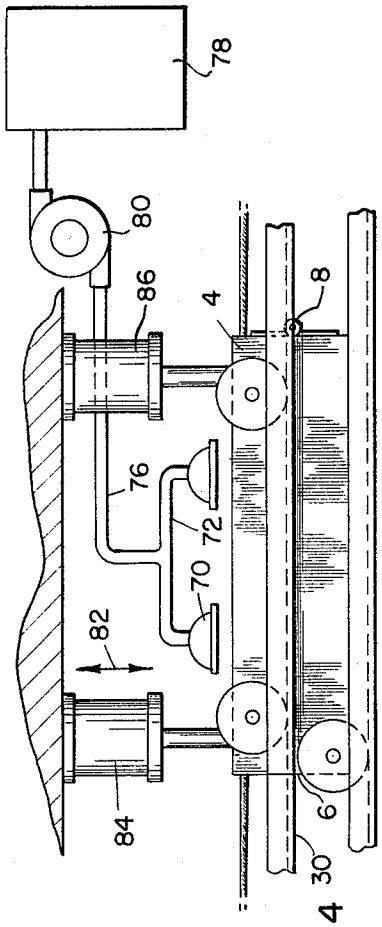


FIG. 4

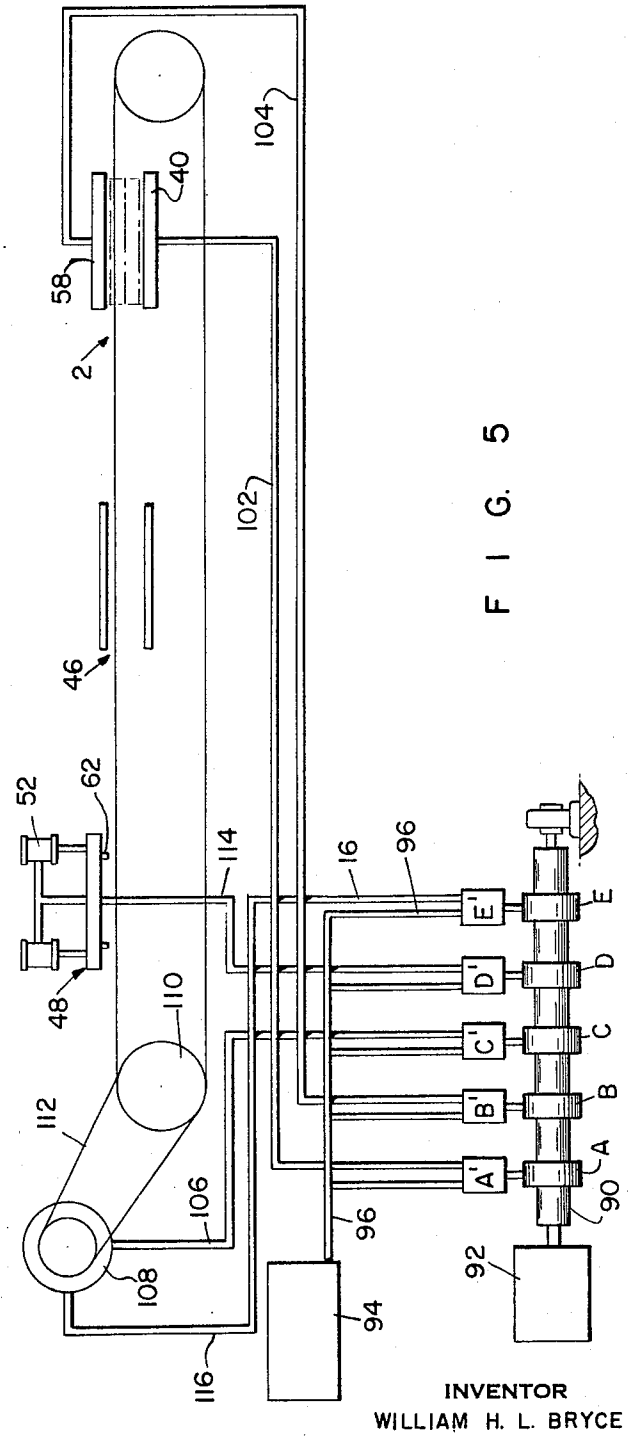


FIG. 5

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AUTOMATIC CORE BLOWING MACHINE

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Claims priority, application Canada, July 26, 1963, 881,143/63
17 Claims. (Cl. 22—10)

The invention relates to automatic core blowing machines and particularly to an adaptor for use with conventional pneumatically operated core blowing machines, to enable these machines to be used in conjunction with new, advanced molding sands. These new molding sands are notably (1) the furfural (Furan) sands (molding sands plus resins) which harden when heated; the hardening reaction is very exothermic and in fact the sands are self-sustaining and bake themselves once initiated, and (2) sands used in the "CO_2 process" which sand consists principally of a sand-sodium silicate mixture which hardens (sets) when exposed to carbon dioxide gas and/or other mediums.

The conventional core blower mentioned above, and with which it is intended that the instant apparatus be used, was designed originally for use with sand-oil mixtures. This sand-oil core blower machine basically comprises a sand-hopper positioned above a laterally reciprocal blow head. A core box comprising cope and drag sections having internal cavities identical to the exterior contour of the core to be produced, and having filling holes, is positioned and clamped beneath the blow head and air pressure forces the oil-sand mixture from the blow head down through the filling holes into the core box, thus completely filling the cavity in the core box with sand-oil mixture. The core box is then removed from the machine, the two halves of the core box (cope and drag) are then separated, and the core formed (which is still soft but which retains its shape due to the viscosity and tackiness of the oil-sand mixture called green-strength) is placed in a tray and conveyed to an oven for heating and hardening. In the machine just discussed the oil-sand mixture was blown into the core box cavity by air pressure, it will be appreciated that the sand compound could also be hand-rammed into the box. These machines are predominantly hand operated.

The conventional process from blowing to oven heating and hardening discussed above usually took about one hour to produce a finished core ready for the next steps in the casting process which are well known to those familiar with foundry art.

With the advent of quick hardening furfural (heat hardening) sands and "CO_2 process" (CO_2 hardening) sands, such core-blowing machines have become obsolete, and the many thousands of dollars spent by the numerous foundries for equipment of this type is considered lost.

The basic object of the instant invention then, is to provide inexpensive equipment suitable for use with these core-blowing machines and which will convert these machines for use with the newly-developed sands, and which will rival new machines particularly designed for use with the new sands but which cost many thousands of dollars more.

The present invention relates also to apparatus for attachment to conventional core-blowing machines, which reduces the steps from initially positioning the core box beneath the blower head to the finished hardened core product to a completely automatic operation.

The automatic operation of the apparatus may be summarized in the following step form.

(1) Filling a core box cavity with Furan (furfural) sand or "CO_2 process" sands using either a conventional core blower or by hand-ramming.

(2) Moving the still closed core box to (a) a heating station in the case of furfural sands or (b) a CO_2 station in the case of CO_2 hardening sands (for example sands coated with sodium silicate) for a quick hardening of these sands into cores, and

(3) Dumping the finished core structures onto slowly moving conveyor belts, from where the cores are eventually taken and placed in packing cases or used in further molding operations.

The present apparatus will now be more specifically described with reference to the accompanying drawings, wherein

FIGURE 1 illustrates a core box comprising cope and drag portions and supplied with wheels for use with the instant invention.

FIGURE 2 illustrates in side perspective view a portion of the apparatus according to this invention.

FIGURE 3 illustrates in side view the apparatus according to this invention.

FIGURE 4 illustrates in side view a modification of the apparatus shown in FIGURE 3 which may be employed when the molding sand is of the CO_2 hardening variety, and

FIGURE 5 is a diagrammatic representation of a cam drum arrangement for the automatic operation of the apparatus of this invention.

In FIGURE 1 an open core box generally indicated at **2** adapted for use in the present invention is shown. The core box consists of two portions, the cope **4** and the drag **6**, which are hinged together in book fashion at **8** in any convenient manner. The drag portion **6** is provided with wheels **10** and **12** (the latter being shown in dotted lines) and the cope is provided with wheels **14**, **16**, **18** and **20** (the latter two wheels being shown in dotted lines). FIGURE 1 also shows corresponding cavities **22** provided in both portions of the box and also filling holes **24** in the cope through which molding sand is introduced into the molding cavities when the core box is in closed position.

In FIGURE 1, a core box wherein the cope and drag portions are hinged directly together, and the wheels are attached directly to the cope and drag portions is shown. Such an arrangement is strictly for simplicity of illustration and description, and it will be understood that hinged frames provided with wheels and adapted to receive standard core boxes may also and preferably be employed.

Numeral **26** represents a cable or chain or the like which is attached to the cope portion of the core box (or to a core box-containing frame) to impart a reciprocating movement to the core box as will hereinafter be described.

FIG. 2 illustrates tracks **28**, **30**, **32** and **34** along which the wheels provided on the core box **2** roll. At the right side of this drawing a core box in closed position or filling position is shown. As the box moves in the direction of arrow **36** wheels **14** and **16** (and **18** and **20**) of the cope portion follow track **30** (and **34**), and no change in the attitude of the cope takes place. However, as wheel **10** (and wheel **12**) of the drag portion **6** rolls to the left in FIG. 2 it will follow the dip in track **28** due to the weight of the drag portion, and because the drag and cope are hinged together at **8** the drag will assume the open position shown at the left in FIG. 2. Although it has been found that the weight of the drag is quite sufficient to cause the box to open, it may be found expedient to groove wheel **10** to track **28** whereby the box is opened by the pull of track **28** on wheel **10**.

FIG. 3 illustrates in side view the apparatus according to the present invention. Numeral **38** represents a blow

head of a conventional core blowing machine, and numeral 40 represents means for clamping a core box tightly against the blow head 38 during the blowing or core box filling step. Only two portions of a conventional core blowing machine are shown in FIG. 3 as such machines are well known in the art and further exemplification here or in the drawings is deemed unnecessary. Two elements for heating the core box are shown at 42 and 44, and while direct flame impingement heating is shown in the drawings it will be understood that any suitable heating device, such as radiant heating, or immersion heaters placed directly in the core box, may usefully be employed. In this drawing a closed core box undergoing a heating treatment is indicated generally at 46, and an open core box from which the formed cores are being removed is indicated generally at 48. A filling hole punching or cleaning assembly is indicated at 50, and two pneumatic pistons for imparting a reciprocal vertical movement to the assembly 50 are shown at 52 and 54.

A conveyor belt 56 is provided beneath the punching and emptying station to catch and convey the formed cores to a packaging station. The cores also cool substantially during their time on the belt.

In operation the apparatus of this invention is as follows: A closed heated core box is positioned beneath the blow head of the core-blowing machine and the core box is tightly clamped against the blow head and plow plate 58 by means of clamp 40. A mixture of sand and heat hardening resin (furfural) is then pneumatically blown into the cavities 22 of the core box through filling holes 24. When the cavities are completely filled with the sand mixture clamp 40 is released and the core box is moved by means of cable 26 into a heating area between heating elements 42 and 44. The heat hardening sand-resin mixture being exposed to further heat immediately begins accelerated hardening. As the hardening reaction in the sand-resin mixture is exothermic, once initiated the hardening process is self-sustained and accordingly a prolonged heating of the core box by external means is unnecessary.

After heating the core box is moved by cable 26 in the direction of arrow 60, and as above described and because of the shape of tracks and the hinged nature of the core box, the core box will assume the open position (more than 90°) indicated at 49. It has been found in practice that in most instances the formed cores will fall by themselves onto the belt 56 without any assistance. However, to completely ensure that the cores are discharged and that the filling holes 24 are clean a punching station is provided at 50 and as the open core box reaches a predetermined position the plate 50 equipped with cleaning prongs 62 is lowered to contact and clean the filling holes in the cope 4. The formed cores drop onto belt 56 and are conveyed away.

After cleaning, plate 50 is elevated to the position shown in FIG. 3, and the core box is returned along the tracks in the direction of the core blowing machine by means of cable 26. It will be appreciated that as the core box is moving toward the core blowing machine the core box will return to its closed position as shown at 46. The core box is then repositioned in the core blowing machine and one complete cycle has been completed.

As earlier disclosed the conventional core blowing machines employed with the apparatus of this invention were not designed for use with heat-hardening sands and it has been found that the residual heat of the core box is transferred to the blower head during their brief contact with each other with the result that the sand-resin mixture tends to set and harden in the filling orifices provided in the blow plate 58. To eliminate the tendency of the sand-resin mixture to clog in the blow plate orifices means for cooling the blow plate and head must be provided. There are of course several ways in which this cooling can be accomplished but it is found to be expedient to provide the blow plate with water channels through which cold water is circulated. See 64 in FIG. 3.

In the above description it has been assumed that the core sand is of the heat-hardening variety. However, when the core sand used is the type which hardens when exposed to carbon dioxide saturation it will be understood that the heating elements will not be necessary and that cooling of the blow plate is equally unnecessary. When CO_2 hardening core sand is used the heating elements may be replaced with apparatus to saturate the sand in the cavities in the core box with carbon dioxide. Other methods of setting the CO_2 hardening sand are of course known in the art, and the core box could be so designed that CO_2 gas is blown through the molding sand during the course of travel of the core box from the core blowing machine to the emptying station.

A type of apparatus for effecting hardening of the CO_2 hardening sand is shown in FIG. 4. The apparatus shown in FIG. 4, and which is to replace the heating elements 42 and 44 shown generally at 46 in FIG. 3, consists of a number of individual rubber cups 70 suspended from a frame 72 and positioned above the track 30. The number of rubber cups correspond to the number of core sand filling holes 24 provided in the cope 4 of the core box (in this case four). The rubber cups are connected by way of tubes 76 to a CO_2 container 78, and a valve 80 provided in the tube 76 regulates the flow of CO_2 gas from the container 78 into the individual rubber cups. Frame 72 which supports the cups 70 is reciprocal in a vertical direction (see arrow 82) under the action of pistons 84 and 86.

As the core box which has been blown full of CO_2 hardening sand leaves the core-blowing machine 38 it advances to the left in FIG. 3 and stops beneath the CO_2 gas injecting apparatus disclosed above and shown in FIG. 4, which replaces the heating station 46. As the core box stops beneath frame 72, the pistons 84 and 86 are activated and the frame lowered so that the rubber cups 70 contact the upper surface of the cope 4 and enclose the sand filling holes 24. Valve 80 is then opened and a supply of CO_2 gas which is under pressure in container 78 flows along tubes 76, into cups 70, down sand filling holes 24 and into the CO_2 hardening sand in the cavities 22 in the core box. When sufficient CO_2 has been injected into the sand in the core box cavities, to effect hardening of the sand, valve 80 is closed, pistons 84 and 86 are activated to raise frame 72 and cups 70 from contact with the core box, and the core box is then conveyed away and emptied as disclosed above.

In FIGURE 4, although the CO_2 injecting apparatus has been shown as being stationary (apart from the vertical reciprocal action) it may be advantageous to mount frame 72 on a track parallel with the track 30 so that the CO_2 injecting apparatus can be carried along with the core box from its travel from the core blowing station to the core emptying station during the injection of CO_2 into the sand, thus speeding up the process.

The operation of the apparatus according to this invention may be effected manually, or, and as is more efficient, completely automatically. In the automatic operation of this apparatus to date applicant has employed an air pressure circuit using reversible air motors to control the positioning (and timing) of the core box carriage with respect to the tracks. Applicant employs a uniformly rotating drum or cylinder upon which are mounted individual cams which activate (in sequence) valves to control the positioning and timing of the core box carriage in a predetermined sequence.

Such a cam drum arrangement is well known and it is believed that a diagrammatic representation of a simple arrangement and a brief description will be adequate. FIG. 5 illustrates such a diagrammatic view. The cam drum indicated at 90 is connected to a motor 92 which revolves the drum slowly at a predetermined and uniform rate of speed. Along the length of the cam drum are positioned various camming members A to E inclusive. Positioned adjacent each of the camming members are pneu-

matic valves A' to F' each of which is connected to an air pressure pump **94** by way of pressure tubes indicated for simplicity by the single reference **96**.

For purposes of this illustration let us assume that the core box **2** (in dotted lines) is positioned directly beneath the blow plate **58** of the core blowing machine.

As drum **90** rotates cam A contacts and opens valve A' thus allowing air under pressure to flow from pump **94** through tube **96**, through valve A', through tube **102**, to activate pneumatic mechanism **40'** (see FIG. 3) to activate clamping mechanism **40** to clamp the core box **2** tightly against the blow plate **58**.

As the drum **90** continues to rotate, core box **2** is held tightly against blow plate **58**, and valve B' is activated by cam B to send air pressure through line **104** to the core blowing machine to induce the blowing of sand into the core box. As the drum continues to revolve cam B closes valve B' thereby stopping the blow, cam A closes valve A' and the clamp **40** releases the core box from against blow plate **58**.

Valve C1 is next opened by cam C and air pressure flows through tube **106** to activate air motor **108** which is connected to pulley **110** by belt **112**. Motor **108** rotates pulley **110**, and the core box **2** is moved from beneath the core blowing machine to the heating (or CO_2 injecting) station indicated generally at **46**. On further activation of motor **108** by the opening again of valve C1 by cam C, the core box is moved to the emptying station indicated at **48** where the cope and drag portions fall open and the cores are discharged from the core box. The core box is maintained at the emptying station, while valve D' is opened by cam D to activate pistons **52** (by way of tube **114**) to lower punches **62** to clean out the sand filling holes **24** in the cope portion of the core box. The punches **62** are then removed from the filling holes upon further rotation of the cam drum **90**; and activation of valve E' by cam E allows air pressure to flow through tube **116** to air motor **108** (which is a reversible air motor) to return the core box to its initial position beneath the blow plate **58**.

While the above discussion of a possible operational mechanism for the apparatus relates to heat hardening sands, it will be apparent that the activation of the CO_2 injection apparatus illustrated in FIG. 4, can also be controlled by similar mechanism.

The above discussion of an air pressure activated control mechanism is in its simplest form, and some variation in this construction may be desirable, especially with the provision of safety valves, pressure regulators, air filters, and the like.

The time necessary for one complete cycle is in the neighborhood of from 15 to 22 seconds, of which about 6 seconds are used for blowing, transfer and dumping and the remainder for the heating cycle. This cycle time can be altered by speeding up or slowing down the cam drum, and individual operations can be changed by moving or changing the cams on the drum.

It has been determined in the case of heat heardening sands that the usual heating period (at **46**) will be in the range of from 10 to 15 seconds at a temperature of 450° F. (±50° F.).

While air pressure activation of the apparatus has been described it is obvious that other methods may be used equally as well. Such may include electric reversing motors with limit switches from the cam controlling the carriage motor and with push button control of cycle and time, etc. Also an all-electric circuit employing limit switches, solenoid valves, timers to control the carriage, blowing, heating time etc. may also advantageously be used.

It is to be understood that the above description and accompanying drawings are to be deemed primarily as illustrative of the preferred mode presently contemplated of carrying out the principles of the invention, and that the device described and illustrated may be modified or

altered in its form, proportions, detail of construction and arrangement of parts without departing from the spirit and scope of the invention as defined in the appended claims.

What I claim and desire to secure by Letters Patent is:

1. In combination with a machine for producing sand cores for use in casting processes, a substantially horizontal track positioned beneath a core blowing machine and extending outwardly therefrom, a core box comprising cope and drag provided on their mating surfaces with corresponding recesses in the shape of the core to be produced, the cope portion being provided with filling holes communicating with said recesses for filling said recesses with core sand, said cope portion and said drag portion being hingedly connected and being provided with wheels for movement along said track, a core sand blowing station directly beneath the core blowing machine, a core sand hardening station positioned in close proximity to said track and close to said core blowing machine, a sand core emptying station comprising a dip in said track whereby said cope and drag portions are opened with respect to each other along their hinge line to an angle of at least 90°, and a filling hole cleaning station comprising a series of punches adapted to engage and clean the filling holes of the cope portion, and means for imparting to said core box movement from said core blowing station, to said core sand hardening station to said core emptying station to said filling hole cleaning station and back to said core blowing machine.

2. Apparatus according to claim **1** said core blowing station comprising a core blowing head positioned on said core blowing machine and clamping means whereby said core box is clamped beneath said head and core sand is blown through said filling holes into the recesses in said core box.

3. Apparatus according to claim **2** wherein the core sand is heat hardening sand, and the core sand hardening station comprises heating means disposed along said track.

4. Apparatus according to claim **3** wherein said core blowing head is provided with cooling means.

5. Apparatus according to claim **1** wherein conveying means are provided beneath said core emptying station.

6. Apparatus according to claim **2** wherein the core sand is carbon-dioxide hardening sand, and the core sand hardening station comprises means for passing carbon-dioxide through the sand in the recesses of the core box.

7. In combination with a machine for producing cores for use in casting processes, a substantially horizontal track positioned beneath said machine and extending outwardly therefrom, a core box adapted for movement along said track and means for moving said core box along said track, said core box comprising cope and drag portions hingedly connected together and being provided on their mating surfaces with corresponding recesses in the shape of sand core to be produced, the cope portion being provided with filling holes communicating with said recesses for filling said recesses with core sand, a core sand blowing head in association with said core blowing machine and means adapted to tightly position said core box beneath said blowing head to enable the filling of said recesses with core sand, means positioned along said track at some distance from said machine to promote hardening of said sand cores, a substantially V-shaped dip provided in said track at a distance from said sand hardening means and whereby the cope and drag portions of the core box are opened along their hinge connection to discharge the hardened sand cores, means for cleaning the filling holes of said cope portion, and means for imparting to said core box a reciprocating motion between said machine and said dip.

8. Apparatus according to claim **7** wherein the core sand employed is heat hardening, and said sand hardening means consists of heating elements disposed adjacent said track.

9. Apparatus according to claim 8 wherein said blowing head is provided with cooling means.

10. Apparatus according to claim 7 wherein the core sand employed is carbon-dioxide hardening, and said sand hardening means consists of means for passing carbon-dioxide through the sand positioned in the recesses of the core box.

11. Apparatus according to claim 7 wherein the movement of the core box along the track is automatically controlled.

12. Apparatus according to claim 7 wherein said filling hole cleaning means consists of punches adapted to be inserted into the filling holes of the cope portion of the core box.

13. In combination with a machine for blowing sand cores and having a blowing head and clamping means adapted to engage a core box to said blowing head, a substantially horizontally disposed track positioned beneath said blowing head and extending outwardly therefrom, a core box comprising cope and drag portions movably positioned on said track and adapted for reciprocal movement therealong, said cope and drag portions being hingedly connected together to allow said drag portion to pivot downwardly from said cope portion at an angle of more than 90°, said cope and drag portions having corresponding recesses provided on their mating surfaces, said recesses being in the shape of the sand core to be produced, the cope portion being provided with filling holes communicating with said recesses whereby the recesses are filled when the core box is positioned beneath the blowing head, a core sand hardening zone comprising heating elements disposed adjacent the track at a distance from the blowing machine, a sand core emptying zone comprising a portion of the track arranged substantially V-shaped whereby said drag portion may pivot in respect of said cope portion, positioned along said track at a distance from said hardening zone, and a filling hole cleaning zone comprising punches adapted to engage said filling holes positioned adjacent said emptying zone, and means for intermittently moving said core box along said track in timed sequence.

14. Apparatus according to claim 13 wherein said blowing head is provided with cooling means.

15. Apparatus according to claim 14 wherein a conveying belt is provided beneath said emptying station.

16. In combination with a machine for blowing sand cores and having a blowing head and clamping means adapted to engage a core box to said blowing head, a substantially horizontally disposed track positioned beneath said blowing head and extending outwardly therefrom a core box comprising cope and drag portions movably positioned on said track and adapted for reciprocal movement therealong, said cope and drag portions being hingedly connected together to allow said drag portion to pivot downwardly from said cope portion at an angle of more than 90°; said cope and drag portions having corresponding recesses provided on their mating surfaces, said recesses being in the shape of the sand core to be produced, the cope portion being provided with filling holes communicating with said recesses whereby the recesses are filled when the core box is positioned beneath the blowing head, a core sand hardening zone comprising means for introducing carbon-dioxide into the recesses in the core box containing core sand disposed adjacent the track at a distance from the blowing machine, a sand core emptying zone comprising a portion of the track arranged substantially V-shaped whereby said drag portion may pivot in respect of said cope portion, positioned along said track at a distance from said hardening zone, and a filling hole cleaning zone comprising punches adapted to engage said filling holes positioned adjacent said emptying zone, and means for intermittently moving said core box along said track in timed sequence.

17. Apparatus according to claim 16 wherein a conveying belt is provided beneath said emptying station.

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