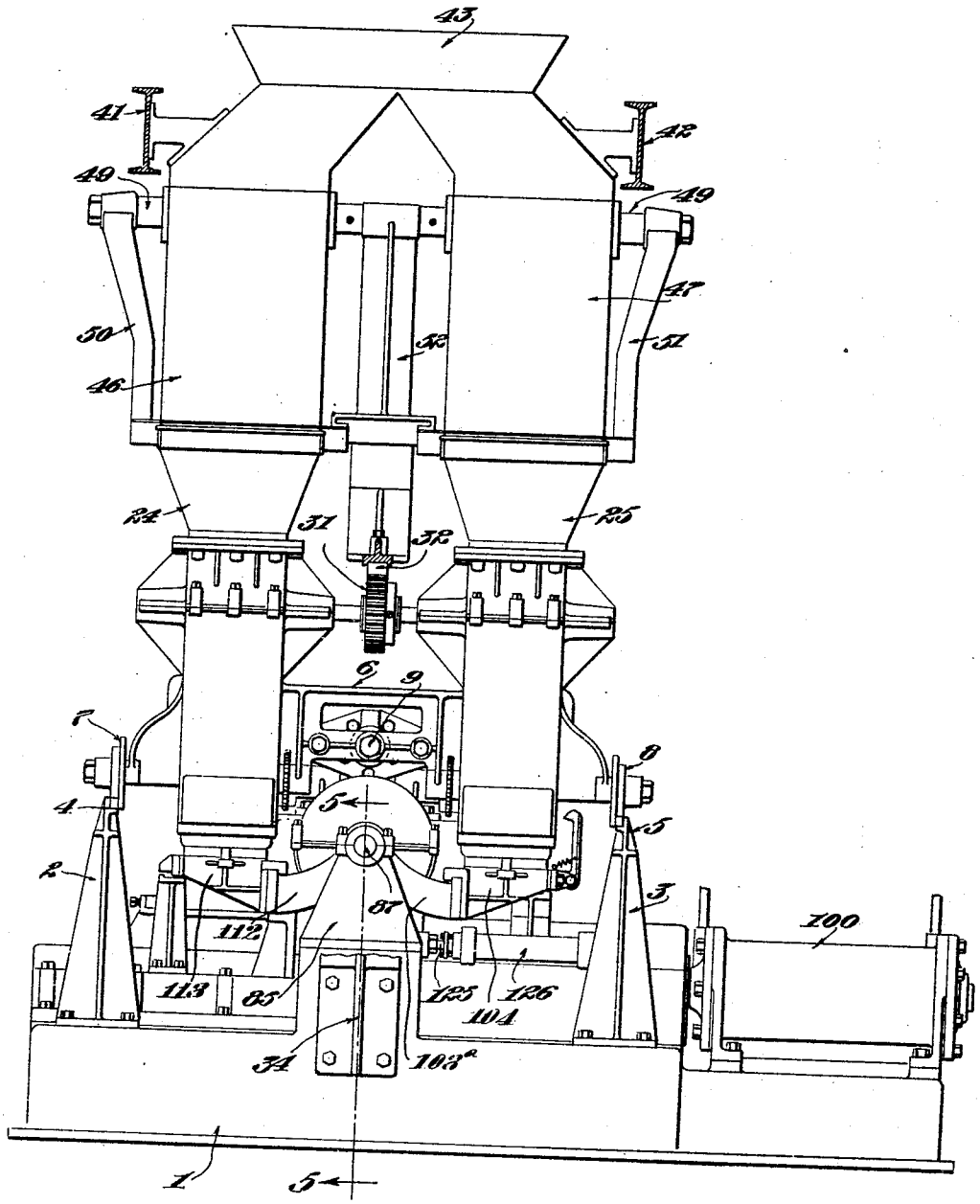
April 21, 1931. C. K. PRINCE 1,801,978

CORE MAKING APPARATUS

Filed Jan. 18, 1927 9 Sheets-Sheet 1

Fig. 1



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April 21, 1931. C. K. PRINCE 1,801,978

CORE MAKING APPARATUS

Filed Jan. 18, 1927 9 Sheets-Sheet 2

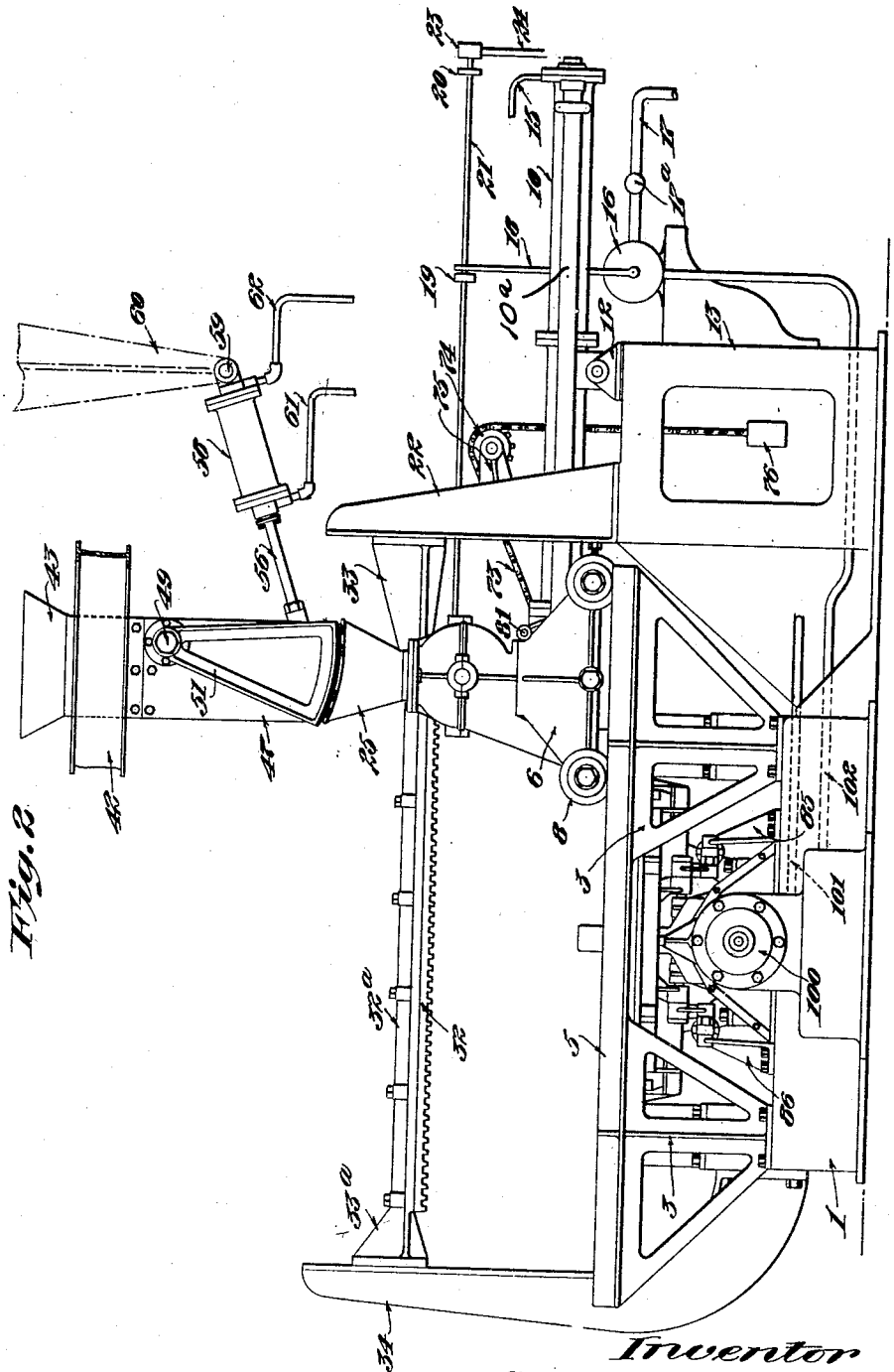

Fig. 2.

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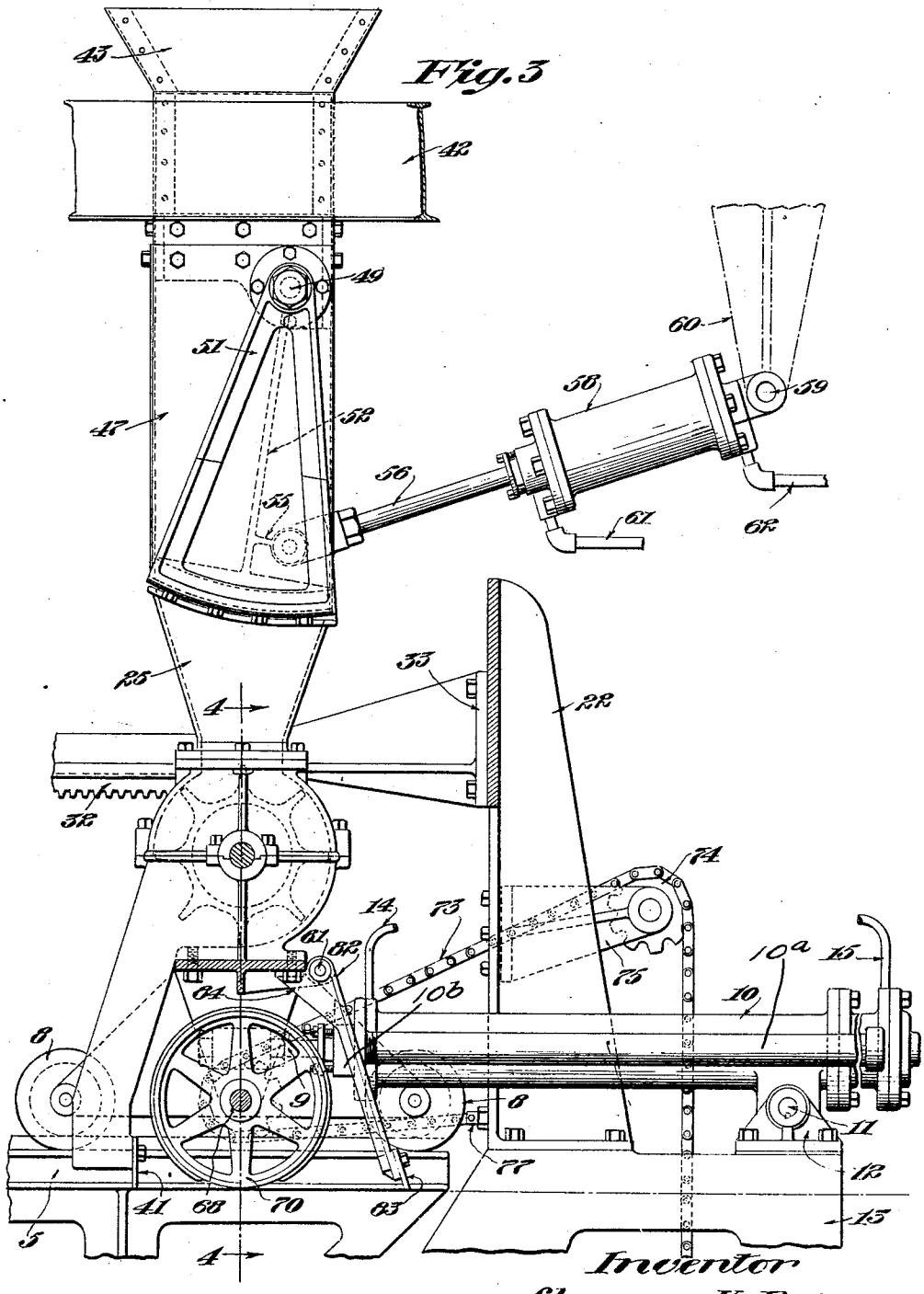
April 21, 1931. C. K. PRINCE 1,801,978

CORE MAKING APPARATUS

Filed Jan. 18, 1927 9 Sheets-Sheet 3

Fig. 3



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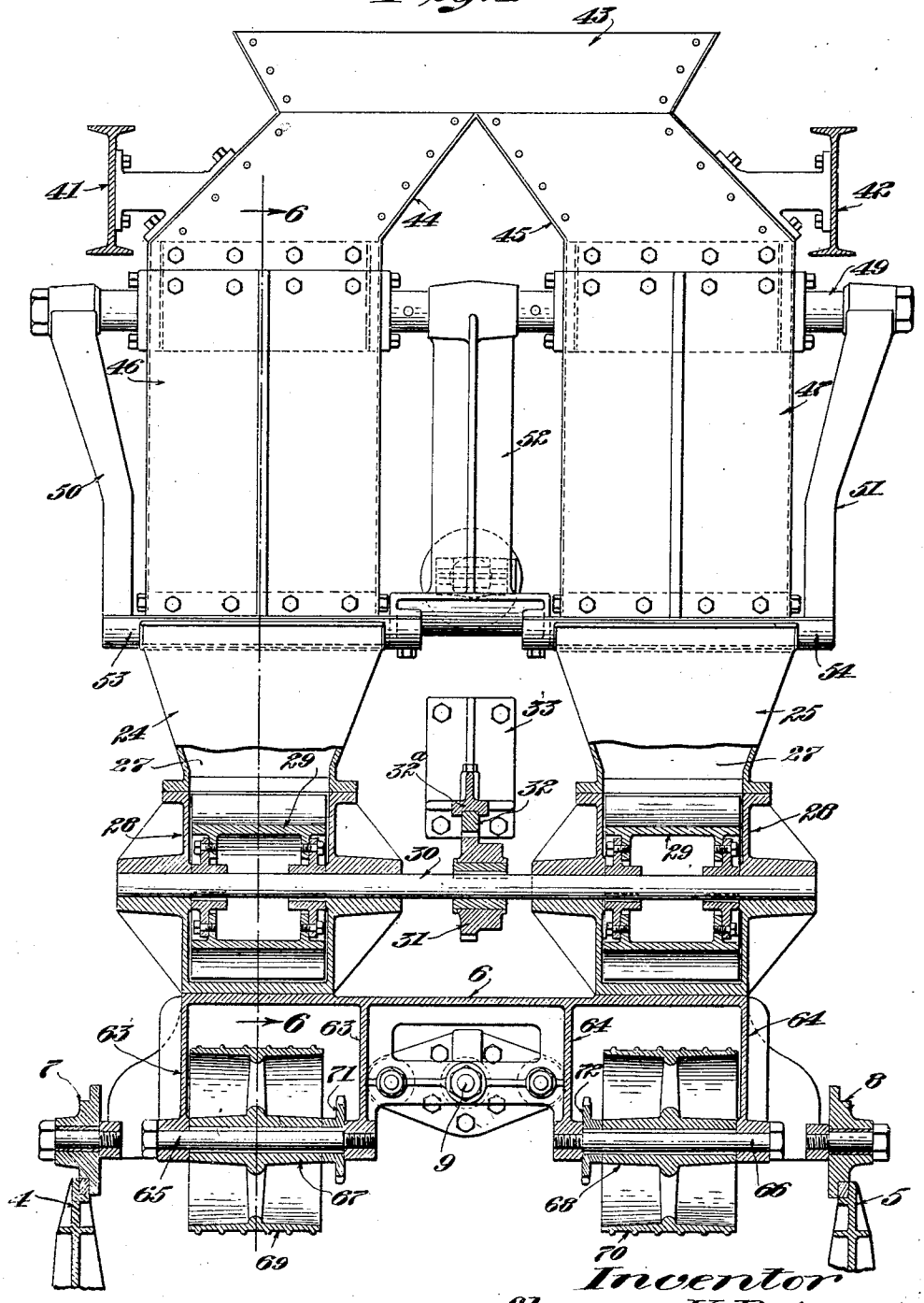
April 21, 1931. C. K. PRINCE 1,801,978

CORE MAKING APPARATUS

Filed Jan. 18, 1927 9 Sheets-Sheet 4

Fig. 4



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April 21, 1931. C. K. PRINCE 1,801,978

CORE MAKING APPARATUS

Filed Jan. 18, 1927 9 Sheets-Sheet 5

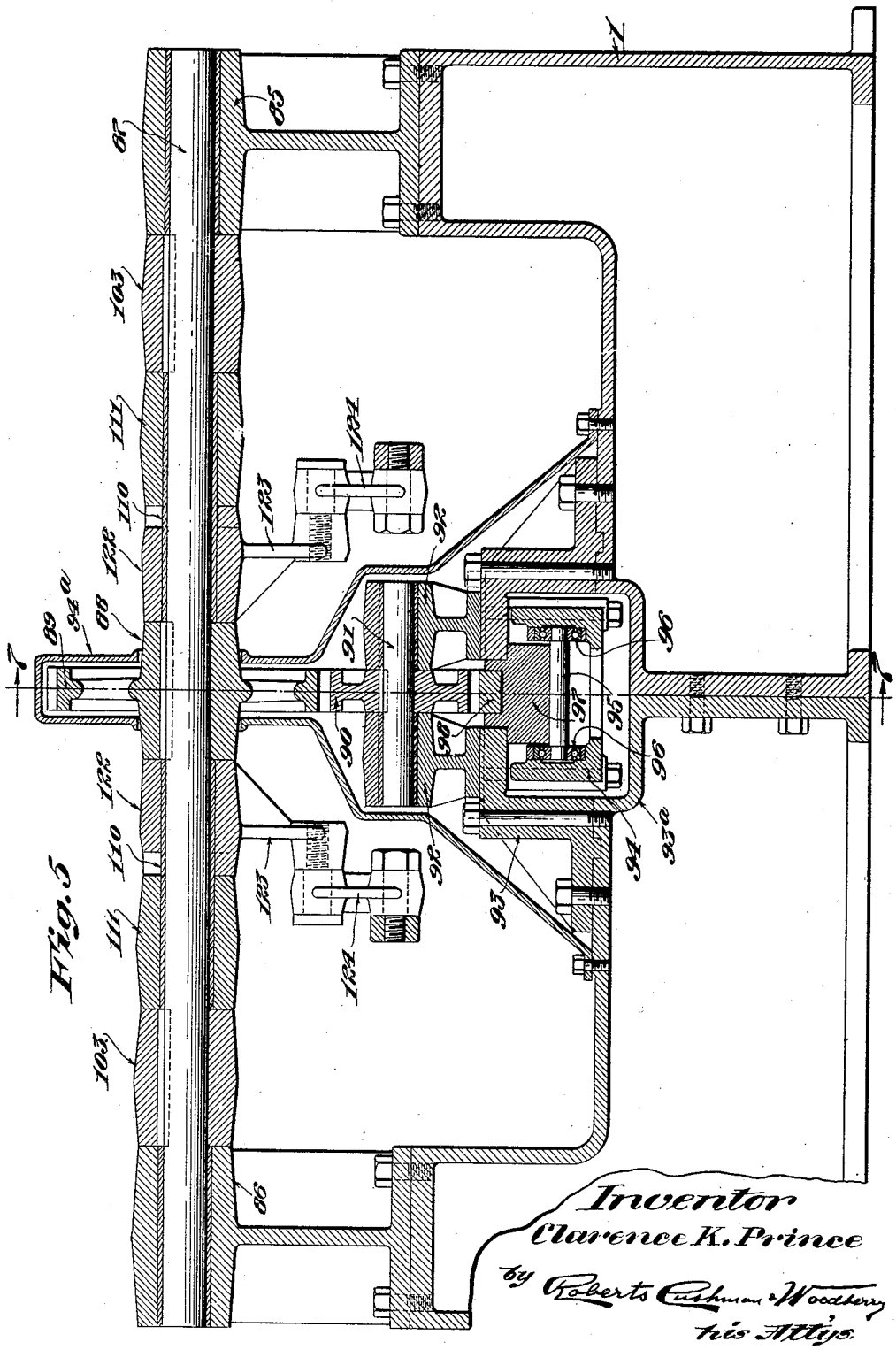

Fig. 5

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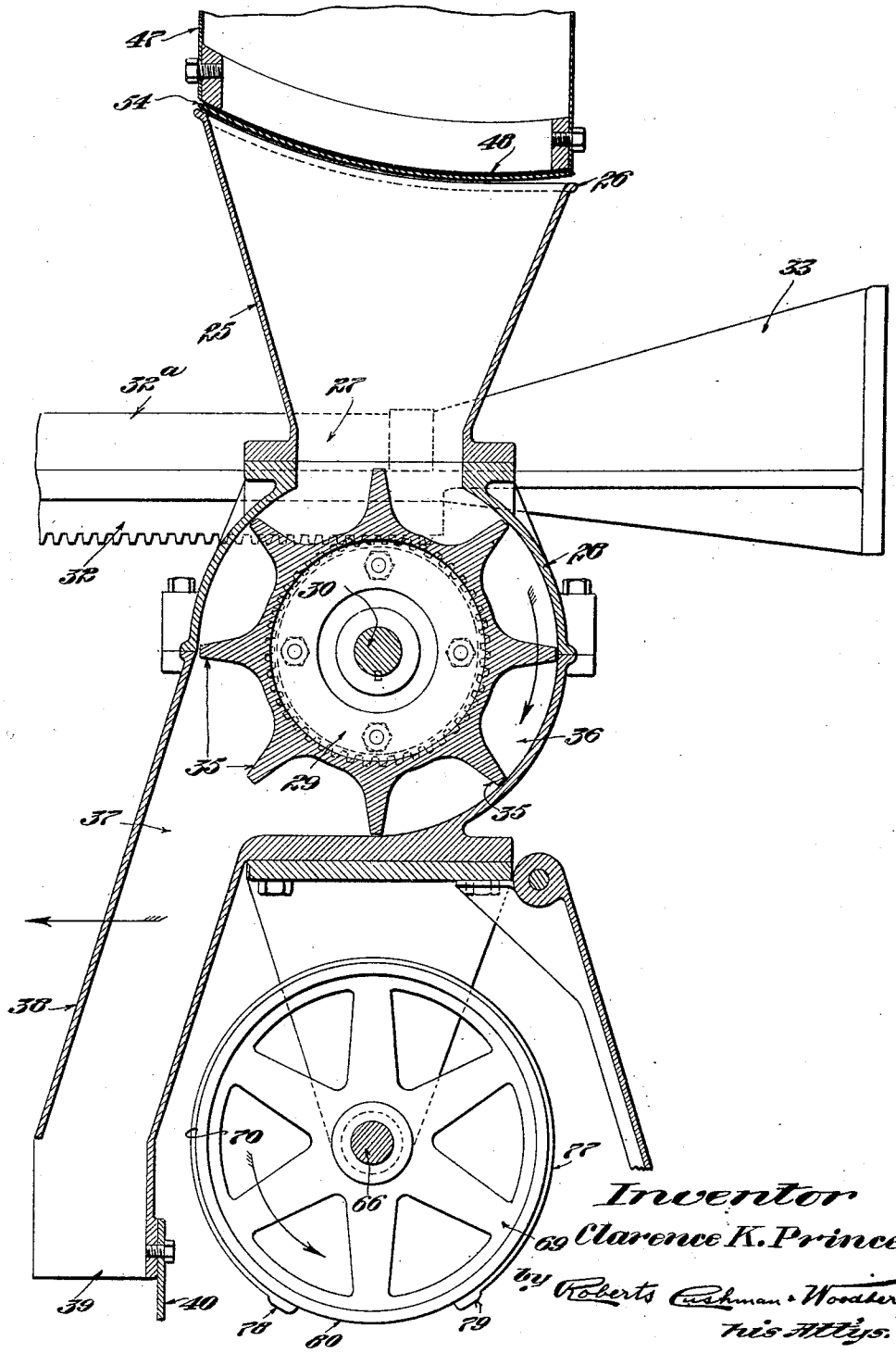
April 21, 1931. C. K. PRINCE 1,801,978

CORE MAKING APPARATUS

Filed Jan. 18, 1927 9 Sheets-Sheet 6

Fig. 6



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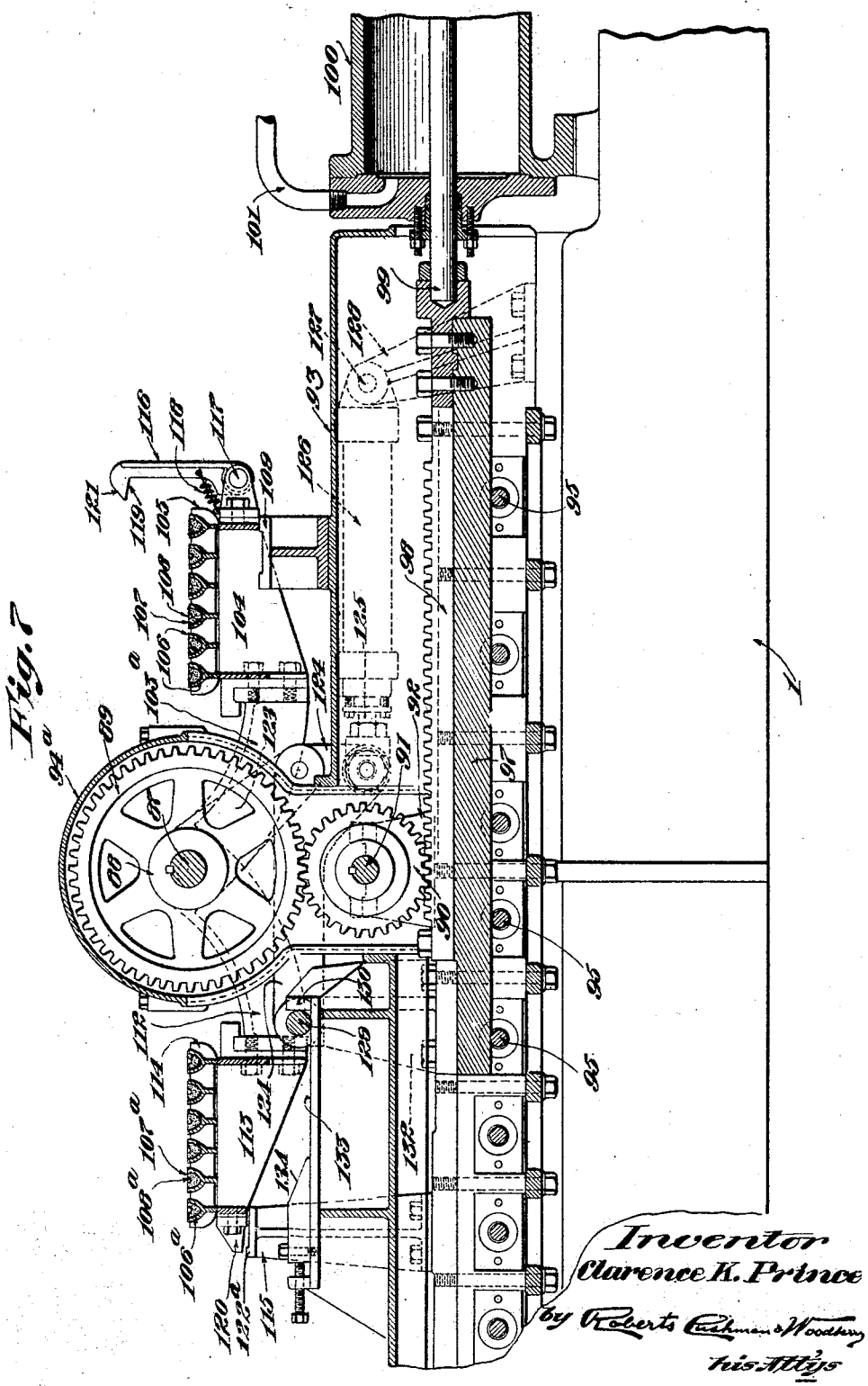
April 21, 1931. C. K. PRINCE 1,801,978

CORE MAKING APPARATUS

Filed Jan. 18, 1927 9 Sheets-Sheet 7

Fig. 7



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April 21, 1931. C. K. PRINCE 1,801,978

CORE MAKING APPARATUS

Filed Jan. 18, 1927 9 Sheets-Sheet 8

Fig. 8

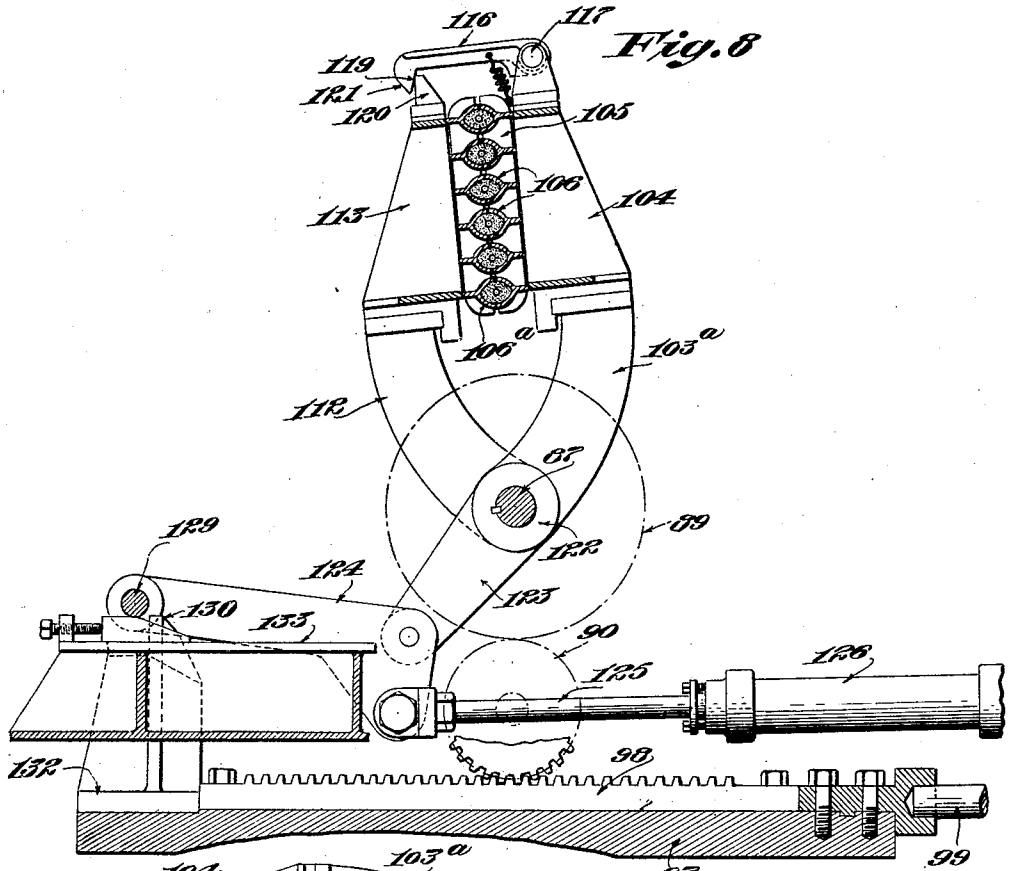
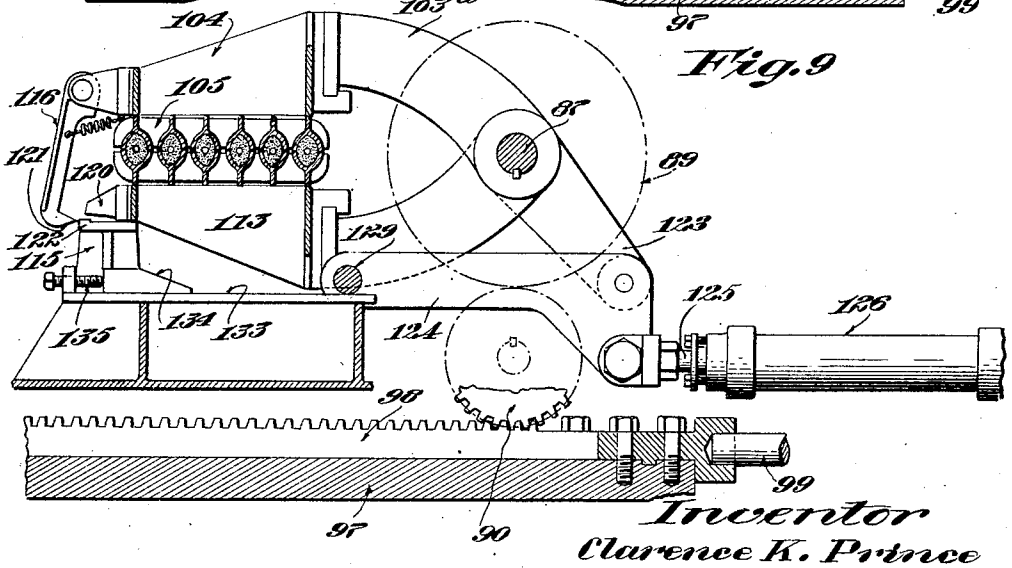


Fig. 9



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April 21, 1931. C. K. PRINCE 1,801,978

CORE MAKING APPARATUS

Filed Jan. 18, 1927 9 Sheets-Sheet 9

Fig. 10

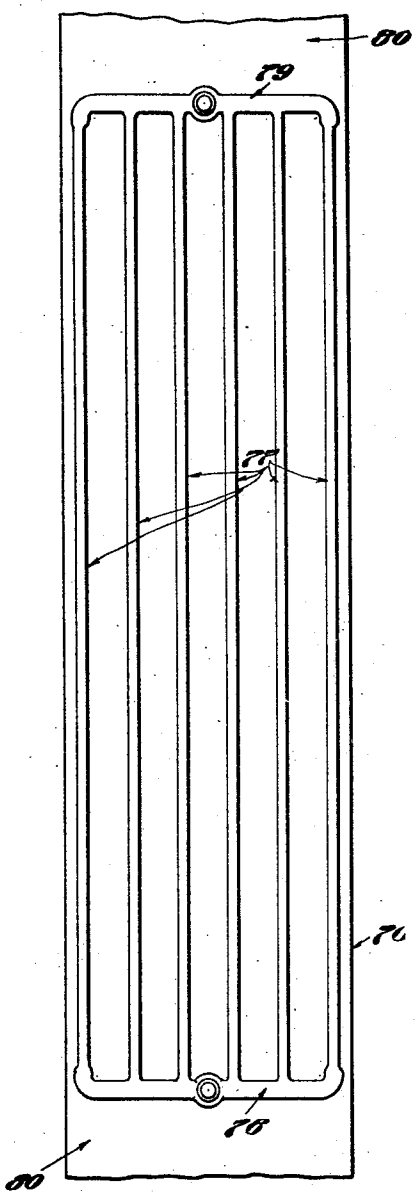
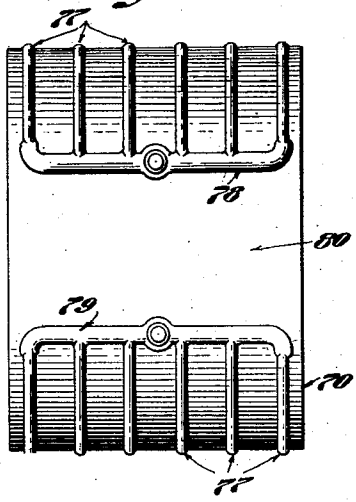


Fig. 11



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UNITED STATES PATENT OFFICE

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CORE-MAKING APPARATUS

Application filed January 18, 1927. Serial No. 161,782.

This invention pertains to the art of founding and more particularly to apparatus for making cores for foundry molds. In accordance with one method of procedure the two halves of the core are hand-molded in separate boxes, and the boxes are then disposed in face to face relation, preferably by swinging or folding them together about one edge after the manner of turning the leaves of a book, thus bringing the opposed core halves into registry whereby to form the complete core. This procedure in which the halves of the core box are folded into engagement to cause the half cores to register is known as the "booking" method, and the resulting core is commonly known as a "booked core". To provide the necessary vents in the finished core, those surfaces of one or both of the half cores which are to be brought into contact are first provided with grooves or channels, and when the core halves are registered, these grooves provide the desired vent passages.

In accordance with the present invention I provide automatic means for filling and compacting the material in the core boxes and for producing the vent grooves, if such be desired, and for booking the core boxes so as to register the complemental half cores and for thereafter moving one of the core boxes so as to leave its half core resting upon the half core in the other box, thereby forming the completed core.

In the accompanying drawings the apparatus is illustrated as designed for forming cores for radiator sections, but the apparatus is of broader utility, and the invention is not in any manner confined to the making of cores of the specific shape herein shown merely for illustrative purposes.

In the accompanying drawings

Fig. 1 is a front elevation of the machine;

Fig. 2 is an elevation of the right-hand side of the machine as viewed in Fig. 1, but to somewhat smaller scale and omitting parts of certain pipe connections;

Fig. 3 is a fragmentary side elevation, with certain parts in section and to larger scale, showing details of the filling and compacting mechanism;

Fig. 4 is a front elevation of the mechanism shown in Fig. 3, certain parts being in vertical section on the line 4—4 of Fig. 3;

Fig. 5 is a vertical section to greatly enlarged scale on the line 5—5 of Fig. 1;

Fig. 6 is a vertical section to large scale substantially on the line 6—6 of Fig. 4;

Fig. 7 is a fragmentary vertical section substantially on the line 7—7 of Fig. 5, but to smaller scale, showing the filled core boxes just prior to the beginning of the booking operation;

Fig. 8 is a fragmentary vertical section, partly in elevation, on the same plane as Fig. 7 but showing the filled core boxes disposed in booked position;

Fig. 9 is a view similar to Fig. 8 but showing the booked core boxes in core delivering position;

Fig. 10 is a developed view of the circumferential surface of a compacting and vent-forming roll; and

Fig. 11 is an elevation of the roll shown in Fig. 10.

Referring to the drawings and more particularly to Figs. 1 to 4 and Fig. 6, the apparatus comprises a main frame or base 1, conveniently formed as a hollow casting, and upon which are mounted various other frame members, some of which are more specifically described hereafter.

At opposite sides of the base, I arrange bracket members 2 and 3 (Fig. 1), respectively, which carry parallel longitudinally extending rails 4 and 5. These rails support a movable carriage 6 provided with trucks or wheels 7 and 8 resting upon the rails 4 and 5 respectively. The carriage 6 is thus supported to move longitudinally of the machine, and in order to impart the desired reciprocating motion to the carriage, I connect one end of a piston rod 9 (Figs. 3 and 4) to the central part of the carriage between the opposite sets of wheels 7 and 8. This piston rod is attached to a piston, not shown, which slides in a cylinder 10 (Fig. 3), pivotally supported at 11 upon a bracket 12 mounted upon a support 13 carried by a projection 14ª extending outwardly from the main base 1.

Pipes 14 and 15 are connected to opposite

ends of the cylinder 10 and lead to a controlling valve structure 16 (Fig. 2) conveniently supported upon the member 13 or in any other suitable position. The details of this valve structure are unimportant and form no part of the present invention, but it may be assumed for convenience in description that this valve structure comprises a housing or casing having a rotor mounted therein provided with suitable control ports and that a supply pipe 17 delivers pressure fluid, for example, compressed air, to the valve housing from which the air is distributed to the various actuating cylinders by the operation of the rotor within the casing. To actuate the rotor I may, for example, provide a lever 18 connected to the rotor shaft and which extends upwardly into the path of a pair of tappets 19 and 20 mounted upon a rod 21 sliding in a guide in a bracket 22 rising from the support 13 and in a bearing 23 carried by a bracket 24 mounted upon any convenient part of the machine frame. One end of this rod 21 is connected to the carriage 6 so that as the carriage moves the rod will be reciprocated and bring the tappets 19 and 20 alternately into contact with the lever 18, thus operating the valve rotor and thereby admitting pressure fluid alternately to the opposite ends of the cylinder 10 and also to certain other fluid pressure cylinders hereinafter described. The arrangement thus described would result in a continuous reciprocation of the carriage 6 so long as pressure fluid were supplied through the pipe 17, and to stop and start the machine the supply pipe 17 may be furnished with a control valve 17a.

As above stated, the specific means for distributing the pressure fluid to bring about the desired sequence of operations of the various parts of the machine forms no essential feature of the invention since it is within the skill of the mechanic to supply such controlling means.

Preferably I provide a dash pot cylinder 10a at each side of the cylinder 10, each dash pot cylinder having a piston connected by a piston rod to a cross-head 10b secured to the piston rod 9. The dash pot cylinders are partly filled with oil or other fluid, and have restricted passages adapted to retard the flow of fluid from one end to the other of the cylinder, thus insuring a steady and uniform movement of the carriage.

Core box charging devices

The carriage 6 supports a pair of laterally spaced receptacles 24 and 25 (Fig. 4), preferably of hopper shape. The upper edges 26 (Fig. 6) of these receptacles are preferably curved on an arc for a purpose hereinafter more fully described, and each receptacle is provided with an outlet 27 at its lower end.

Each of the receptacles 24 and 25 is directly mounted upon a gate housing 28 forming a part of the carriage 6. These gate housings are preferably of substantially circular contour and contain rotary gates 29 for controlling the delivery of material from the hoppers 24 and 25. These gates 29 are supported upon a shaft 30 (Figs. 4 and 6) which is journaled in suitable bearings carried by the housings 28. At a point intermediate the housings 28 the shaft 30 is provided with a pinion 31 (Figs. 1 and 4) which meshes with a stationary rack 32 (Fig. 3). This rack is carried by or forms part of a bar 32a which is supported at one end by means of a bracket 33 attacked to the member 22 above referred to. At its opposite end the bar 32a is supported by a bracket 33a attached to an upright member 34 secured to the base member 1. The rack 32 is substantially horizontal and parallel to the rails 4 and 5 and as the carriage 6 moves back and forth along the rails 4 and 5, the engagement of the pinion 31 with the rack 32 causes the shaft 30 to turn so as to rotate the gates 29.

Each of these gates 29 comprises spaced hub portions secured to the shaft 30 and a rim portion comprising a series of spaced outstanding teeth 35 (Fig. 6) separating pockets 36. The ends of the teeth 35 substantially contact with the inner surface of the housing 28, thus determining the discharge of material from the hopper through the housing. Moreover, these teeth 35 contitute agitating elements which stir up the material at the lower part of the hopper and prevent it from bridging in the narrow outlet 27. As each gate rotates it carries portions of the filling material with which the hopper is supplied downwardly through the housing 28 and delivers it into a downwardly directed passage or chute 37 provided by an extension 38 of the housing 28. The passage 37 terminates at the point 39 slightly below the plane of the rails 4 and 5 and just above the upper surface of the core boxes hereinafter to be described. Preferably a shield 40 is attached to the lower part of the extension 38 so as to prevent spilling the filling material beyond the end of the core box.

At a suitable point above the right-hand end of the machine, as viewed in Fig. 2, I provide suitable supports 41 and 42 (Figs. 2, 3 and 4). These supports may consist of I-beams or other structural elements which may be mounted upon uprights carried by the base of the machine or which may form portions of or be supported by the building in which the apparatus is arranged. These supports 41 and 42 carry a supply reservoir for the core box filling material. This supply reservoir as here shown comprises the top member 43, preferably of hopper shape, to facilitate filling. From this upper part 43 divergent chutes 44 and 45 (Fig. 4) extend downwardly to the upper ends of a pair of spaced vertical reservoirs or compartments

46 and 47, respectively, which are spaced apart the same distance as the receptacles or hoppers 24 and 25 above referred to, and which are adapted to register with the upper ends of said hoppers when the carriage 6 is at one end of its stroke. The lower ends of the reservoir receptacles 46 and 47 are of arcuate curvature, as shown at 48 in Fig. 6, substantially concentric with the upper edges 26 of the hoppers 24 and 25 respectively but slightly spaced above the latter.

The walls of the reservoirs 46 and 47 support suitable bearings for a transverse shaft 49 (Figs. 2, 3 and 4). This shaft is furnished at its opposite ends and at its central portion, intermediate reservoirs 46 and 47, with depending segmental arms 50, 51 and 52 respectively. The arms 50 and 52 support a curved gate member 53 which normally closes the lower end of the reservoir 46, while the arms 51 and 52 support a curved gate member 54 normally closing the lower end of the reservoir 47.

The segmental arm 52 is provided with a bracket 55 (Fig. 3) near its lower end to which one end of a piston rod 56 is pivotally attached. This piston rod is attached to a piston sliding in a cylinder 58 pivotally supported at 59 upon a suitable bracket 60 mounted upon the machine frame or carried by the enclosing structure. This cylinder 58 is connected by means of pipes 61 and 62 to the controlling valve housing 16, and the valve ports are so arranged that whenever the carriage 6 reaches its extreme limit of movement in the right-hand direction, as viewed in Fig. 2, pressure fluid is admitted to the cylinder 58 to swing the gate members 53 and 54 from below their respective reservoirs 46 and 47, thus permitting filling material to drop into the corresponding hoppers 24 and 25, the piston in the cylinder 58 immediately returning to normal position to close the gates and shut off further flow of filling material.

Referring particularly to Figs. 3, 4, 10 and 11, the carriage 6 is provided with pairs of depending brackets 63 and 64 respectively which support horizontally aligned shafts 65 and 66. These shafts are preferably screw-threaded at one end and provided with heads at the other so that they may be removed at will to permit the rollers which they carry to be exchanged for other rollers.

The shafts 65 and 66 support compacting and vent-forming rollers 69 and 70 having tubular hubs 67 and 68 respectively adapted to turn freely upon the respective shafts. Sprocket wheels 71 and 72 are fixedly secured to the hubs 67 and 68 and a sprocket chain 73 (Figs. 2 and 3) passes around each of the sprocket wheels 71 and 72. Each of the sprocket chains 73 passes up over a corresponding idler sprocket 74 mounted upon brackets 75 carried by the member 22, and the lower end of each chain 73 is furnished with a weight 76. The opposite end of each chain 73 is fixedly secured at the point 77 (Fig. 3) to the member 22. This arrangement of chains and sprocket wheels causes the rollers to rotate at a fixed and determined speed as the carriage 6 moves backwardly and forwardly along its rails; the parts are so relatively disposed that the peripheral surfaces of the rollers are substantially tangent to the upper surfaces of the corresponding core boxes hereafter described.

The rim of each of the rollers, for example, the roller 70 shown in detail in Figs. 10 and 11, is provided with a plurality of circumferentially extending parallel spaced vent-forming ribs 77, and these parallel ribs are preferably united at their opposite ends by transverse ribs 78 and 79 respectively. The length and number of the ribs 77 depends upon the size and character of the core which is being formed, but in any case the roller should be of such diameter that the ribs 77 need not extend completely around the circumference, but on the other hand should leave a space 80 of greater or lesser extent between their ends.

In order to secure the desired result the rollers must not make more than one complete rotation during the movement of the carriage 6 in one direction, and as the machine is adapted to support core boxes of different lengths, it may become necessary to exchange the rollers for others of different diameters in accordance with the length of the boxes employed. For this reason I have arranged the shafts 65 and 66 so as to be readily removable.

Upon the carriage 6 I also mount a pair of transverse shafts 81, each carrying a scraper arm 82 which supports a scraper member 83 at its lower end. Each arm 82 is also furnished with a stop member 84 adapted to engage a fixed part of the carriage so as to limit the movement of the scraper arm in one direction. If desired, I may provide means for lifting the scraper arms as the carriage makes its reverse stroke, but I have not shown such means herein.

Core booking devices

Referring now more especially to Figs. 1, 5, 7, 8 and 9, I mount upon the base member 1 supporting brackets 85 and 86 having bearings for a shaft 87 extending longitudinally of the machine. At a central point this shaft carries the hub 88 (Fig. 5) of a gear 89, the hub 88 being keyed or otherwise secured to the shaft. The gear 89 meshes with a pinion 90 mounted upon a shaft 91 supported in bearing brackets 92 carried by an elongate housing 93 which in turn is supported upon a transverse web 93a forming a part of the base member 1.

The housing 93 extends transversely across the machine, and within this housing I arrange a series of shafts or rollers 95 (Figs. 5 and 7) supported at their opposite ends in antifriction bearings 96, preferably mounted in brackets 94 or other suitable supporting means carried by the housing 93, and the shafts 95 form a horizontally disposed series, being spaced apart and supporting a reciprocating drive member or bar 97. The bar 97 carries a rack 98 which meshes with the pinion 90. A piston rod 99 is secured to one end of the bar 97, and this rod is attached to a piston, not shown, sliding in a cylinder 100 (Figs. 2 and 7) supported upon the base 1. The cylinder 100 is connected by means of pipes 101 and 102 respectively to the valve housing 16, and by the actuation of the valve in the housing 16, fluid is admitted alternately to opposite ends of the cylinder 100, thus reciprocating the rack 98, turning the pinion 90, and causing the gear 89 to oscillate.

The shaft 87 carries a pair of hub members 103 disposed respectively adjacent to the bearings 85 and 86, and these hubs are keyed to the shaft and support a pair of arms 103^a to which a core box support 104 (Figs. 1, 7, 8 and 9) is attached. For convenience in further description this core box carrier or support 104 will be termed the "dumping" core box support or carrier and carries a core box 105 which, while removable for interchange with core boxes of other shapes, is normally secured to the support 104, and in effect constitutes a part of the support.

The core box 105 as here shown has a plurality of spaced compartments 106 adapted to be filled with the core material 107 in which the vent grooves 108 are formed, as will hereinafter be described. During the filling operation the support 104 rests upon an anvil member 109 conveniently mounted upon a housing 93 (Fig. 7) which covers the gear 89 and associated parts. The gear 89 is also furnished with a housing 94^a (Fig. 5) which extends downwardly and covers the pinion 90 and the parts immediately below the latter.

The shaft 87 also carries a pair of sleeves 110 disposed at opposite sides of the hub 88. The sleeves 110 are free to turn upon the shaft 87, and each sleeve carries a hub 111 which is fixedly secured to the sleeve. The hubs 111 carry arms 112 to which is attached the core box support on carrier 113. For convenience in description this core box support 113 is hereafter referred to as the "receiving" core box support. This support carries the core box 114 (Fig. 7) having compartments 106^a complemental to the compartments 106 of the core box 105. These compartments 106^a are adapted to receive the filling material 107^a in which the vent grooves 108^a are formed. When in the filling position the support 113 rests upon the anvil 115 suitably supported by the machine frame.

The support 104 carries a latch member 116 pivotally mounted at 117 and is provided with a spring 118 which tends to retain it in latching position. This latch comprises a hook member 119 which is adapted in certain positions of the core box to engage an abutment member 120 carried by the core box support 113, thereby to lock the core box supports together with their core boxes in registry. The hook member 119 of the latch is provided with a cam surface 121 which is adapted at certain times to engage a releasing abutment 122^a (Fig. 9) carried by a fixed part of the frame whereby to disengage the latch hook from the part 120.

The sleeves 110 also carry hubs 122 from which arms 123 (Fig. 5) extend, the arms 123 being fixed to or integral with the hubs 122. The hubs 122 are fixed to the sleeves 110 so as to turn therewith.

The free ends of the arms 123 are pivotally connected to bell crank levers 124 (Figs. 5, 7, 8 and 9) having short arms which are pivotally secured to piston rods 125. The piston rods 125 are attached to pistons, not shown, sliding in cylinders 126. These cylinders constitute cushioning means for retarding the movement of the core box support 113, at least in a counterclockwise direction, and for this purpose the cylinders 126 may be in the nature of dash pots adapted either for the circulation of oil through suitable restricted orifices or for the passage of air through such restricted orifices. Since these dash pot pistons may be of any usual form, they are not herein shown in detail nor claimed except in combination.

The bell crank levers 124 have long arms which support the opposite ends of a transverse rod or bar 129. This rod or bar normally engages the vertical surfaces of an abutment member 130 (Fig. 7) carried by a bracket 132 secured to the drive member or rack-carrying bar 97. Thus as the bar moves to the left (Fig. 7) the abutment 130 pushes the bar 129 ahead of it, thus swinging the lever arms 123 in a clockwise direction as viewed in Fig. 8. During this movement the bar 129 travels along the upper horizontal surface of a guide member 133 supported by the frame.

Adjacent to the left-hand end of the guide member 133 I provide a cam having an inclined or wedge-like surface 134. Preferably this cam is adjustable by means of a set screw 135 or equivalent means. The height of this cam is such that as the bar 129 rides up the inclined surface of the cam the bar is eventually raised to such a height that it escapes from behind the abutment 130 so that continued movement of the abutment 130 to the left, as viewed in Figs. 7 and 8, fails to impart any further motion to the lever arms 123.

Operation

The operation of the apparatus is substantially as follows, it being assumed that the parts occupy the positions shown in Figs. 2 and 7, but that the core boxes are empty. The core box 114 having been placed upon the support 113 by the workman, and temporarily attached to the support, the valve 17ª or other starting device is actuated to admit pressure fluid to the valve housing 16 and thence to the cylinder 58. The gates 53 and 54 are thereupon opened, permitting filling material from the reservoirs 46 and 47 to drop into the hoppers 24 and 25. The gates 53 and 54 immediately return to normal position and the carriage 6 moves toward the left, as viewed in Fig. 2, while the rotary gates 29 turn and deliver filling material from the hoppers 24 and 25 down through the chutes 37 into the respective core boxes 105 and 114. The carriage continues to travel to the left across the tops of the core boxes, and as it travels the filling material is deposited in the core boxes and is compacted by the action of the rollers 69 and 70. Surplus material is scraped off from the top of the core boxes by the action of the scrapers 83. When the carriage has finished its travel to the left, the valve 16 is automatically actuated to reverse the movement of the piston in the cylinder 10 and the carriage begins its travel toward the right. During this time, if desired, and by any means or by the hand of the workman, the scrapers 83 may be raised from the core boxes although this is not necessary. During this return movement the rollers 69 and 70 impress their ribs 77, 78 and 79, in the smoothed and compacted upper surface of the material in the core boxes, so as to form grooves in the material filling the core boxes.

As above described, the diameter of the rolls 69 and 70 is so chosen that as the carriage makes its return movement these rolls make only a partial turn so that the pattern of the ribs upon the rolls is impressed but once in the surface of the material in the core box. If longer or shorter core boxes are used, the rolls are correspondingly changed in size. Moreover, as above described, since the rolls are constrained to move at a predetermined rate by means of the chains 73, there can be no slippage between the surface of the rolls and the material in the core boxes so that the ribs are accurately impressed in the material and the material is not pushed endwise of the core boxes so as to disturb its uniform texture.

After the carriage has returned to its original position, pressure fluid is admitted to the cylinder 100, causing the rack bar 98 to move to the left as viewed in Figs. 7, 8 and 9, thus through the gears 90 and 89 swinging the arms 103ª in a counterclockwise direction. At the same time the abutment 130, acting on the rod 129, swings the arms 112 in a clockwise direction. The relative speeds of movement of the arms 103ª and 112 are so regulated by properly choosing the gears 90 and 89 that the core boxes 105 and 114 meet in registering relation in a plane somewhat inclined (for example about 70°) to the vertical and preferably inclining toward the normal position of the core box 114. At substantially the instant that the core boxes register, the latch 116 snaps down over the abutment 120 and locks the separate box cores together so that they become in effect a single unit. At the same time that the latch locks the core boxes together, the cam 134 raises the rod 129 out of engagement with the abutment 130, thus releasing the core box support 113 from the driving mechanism. The support 113 is thus free to reverse its movement, and as the support 104 continues to swing in a counterclockwise direction the united core boxes are swung down as a unit in registering contact to the position shown in Fig. 9. During the latter movement, the piston in cylinder 100 acts in opposition to the dash pot cylinders 126 so that the movement of the united boxes is slow and steady and in effect cushioned by the dash pot action. As the support 113 engages the anvil 115 the latch 116 is released from the abutment 120 by the member 122ª. At about this time or slightly afterward the pressure fluid in the cylinder 100 reverses the motion of the piston rod 99, thus swinging the core box support 104 back to its original position, but as the core box 104 rises from the position shown in Fig. 9, the half core contained within it is delivered therefrom and remains resting upon the half core in the core box 114. The workman now removes this core box 114 with the completed core from the support 113 and places it in the oven or other device employed for hardening or baking the cores, and places another empty core box upon the support 113, and, as during the booking operation just described, the hoppers 24 and 25 have received another charge, the machine is ready for a repetition of the above-described cycle.

The machine thus automatically forms booked cores and continues the formation of such cores as long as pressure fluid is supplied and fresh core boxes are mounted at the proper intervals upon the support 113.

While one specific embodiment of the invention has herein been illustrated by way of example, it is to be understood that various changes in shapes, proportions, and relative arrangement of parts may be made without departing from the spirit of the invention.

I claim:

1. Apparatus of the class described comprising means for supporting complemental core boxes, mechanically operable means for simultaneously filling said boxes, and means for booking said boxes.

2. Apparatus of the class described comprising means for supporting a core box in a substantially horizontal position, a carriage movable across the top of the box, means for moving the carriage, a filling material receptacle mounted on the carriage, the receptacle having a delivery orifice, a rotary gate controlling said orifice, a gear connected to said gate, and a stationary rack with which the gear meshes whereby movement of the carriage across the core box turns the gate.

3. Apparatus of the class described comprising means for supporting a core box in a substantially horizontal position, a carriage movable across the top of the box, means for moving the carriage, a receptacle for filling material mounted on the carriage, the receptacle having a delivery orifice, a rotary gate controlling said orifice, said gate having peripheral pockets separated by radial teeth, a gear connected to the gate, and a stationary rack with which the gear meshes whereby movement of the carriage across the core box turns the gate.

4. Apparatus of the class described comprising means for supporting a core box in substantially horizontal position, a stationary reservoir for holding filling material, a carriage normally disposed below said reservoir, means for moving the carriage across the top of the core box, a hopper mounted on the carriage, and a movable gate controlling the delivery of filling material from the reservoir to the hopper.

5. Apparatus of the class described comprising means for supporting a core box in substantially horizontal position, a carriage movable across the top of the core box, said carriage having a receptacle for holding filling material, means for moving the carriage, a stationary reservoir for filling material disposed at one end of the path of the core box and above the latter, a gate controlling the delivery of material from the reservoir, and means for actuating the gate for delivering material from the reservoir to the receptacle on the carriage when the receptacle is below the reservoir.

6. Apparatus of the class described comprising means for supporting a core box in substantially horizontal position, a stationary reservoir for filling material, a carriage normally disposed below said reservoir, means for moving the carriage across the top of the receptacle, a hopper mounted on the carriage, a swinging gate controlling the delivery of material from the reservoir to the hopper, and power actuated means for moving the gate.

7. Apparatus of the class described comprising means for supporting a core box in substantially horizontal position, a stationary reservoir for holding filling material, a carriage normally disposed below said reservoir, means for moving the carriage across the top of the receptacle, a hopper mounted on the carriage, a gate controlling the delivery of filling material from the reservoir to the hopper, and a fluid actuated piston for moving the gate.

8. Apparatus of the class described comprising means for supporting a core box in substantially horizontal position, a stationary reservoir for holding filling material, a carriage normally disposed below said reservoir, means for moving the carriage across the top of the receptacle, a hopper mounted on the carriage, means for determining the delivery of material from the reservoir to the hopper, and means for regulating the delivery of material from the hopper to the core box.

9. Apparatus of the class described comprising means for supporting a core box in substantially horizontal position, a carriage movable across the top of the core box, means for reciprocating the carriage a fixed distance in opposite directions, a roller supported by the carriage, a sprocket wheel secured to the roller, a chain engaging the sprocket wheel, one end of the chain being fixed, and a weight attached to the other end of the chain.

10. Apparatus of the class described having means for forming a vent in the upper surface of the material filling a core box, said means comprising a roller having a circumferential rib projecting from its peripheral surface, the rib being less than the circumference of the roll in length, and means for turning the roll through an arc not substantially greater than three hundred and sixty degrees.

11. Apparatus of the class described comprising means for supporting a core box in substantially horizontal position, a carriage movable across the top of the core box, means for reciprocating the carriage a fixed distance in opposite directions, a roller supported by the carriage, the roller being interchangeable with other rollers, and vent-forming ribs projecting from the peripheral surface of the roller.

12. Apparatus of the class described having means for forming a vent in the upper surface of material filling a core box, said means comprising a roller having a plurality of parallel circumferentially extending ribs projecting from its peripheral surface, the ribs being less in length than the circumference of the roll, a transverse rib uniting said parallel ribs, and means for oscillating the roll through an arc not greater than three hundred and sixty degrees.

13. Apparatus of the class described having means for forming a vent in the upper surface of material filling a core box, said means comprising a roller having a plurality of spaced parallel circumferentially extending ribs projecting from its peripheral surface, the ribs being less in length than the circumference of the roll, transverse ribs

uniting said parallel ribs at each end, and means for oscillating the roller through an arc approximating the length of said parallel ribs.

14. Apparatus of the class described comprising means for supporting a core box, a carriage movable across the top of the core box, means for reciprocating the carriage a fixed distance in opposite directions, and a roller supported by the carriage, the roller being interchangeable with other rollers, and having ribs projecting from its peripheral surface, one rib extending circumferentially and another rib extending transversely of the roller.

15. Apparatus of the class described comprising means for supporting a core box in substantially horizontal position, means for filling the box, a compacting roller having a vent-forming rib on its peripheral surface, a scraper, and means for moving the roller and scraper in one direction along the top of the box to compact the material and level it, and for thereafter moving the roller in the opposite direction to impress a vent-forming channel in the leveled material.

16. Apparatus of the class described comprising means for supporting complemental core boxes in substantially horizontal position, and mechanically operable means for simultaneously filling said boxes.

17. Apparatus of the class described comprising means for supporting a pair of complemental core boxes, mechanically operable means for simultaneously filling said boxes, and means for thereafter simultaneously compacting the material filling said boxes.

18. Apparatus of the class described comprising means for supporting a pair of complemental core boxes in substantially the same horizontal plane, a carriage movable across the tops of the boxes, and means mounted on the carriage for simultaneously delivering filling material to both boxes as the carriage passes across them, means for simultaneously compacting the material in the filled boxes and for making vent grooves in the upper surface of the material filling both boxes, and means for moving the supporting means to bring the boxes into booked relation.

19. Apparatus of the class described comprising a reciprocating carriage, a shaft parallel to the direction of movement of the carriage, a pair of core box supports mounted to swing about the axis of the shaft, a core box mounted on each of said supports, the core boxes normally occupying a horizontal plane below the path of the carriage, means mounted on the carriage for holding a supply of filling material, means for advancing the carriage across the boxes while delivering filling material to both boxes, and means for swinging the core box supports to bring the filled boxes into booked relation when the carriage has returned to normal position.

20. A machine of the class described comprising a pair of core boxes normally spaced apart and means for simultaneously swinging said boxes in arcuate paths and at relatively different speeds until they register with one another.

21. A machine of the class described comprising a pair of core boxes normally spaced apart and disposed substantially horizontally and means for simultaneously swinging said boxes about a common axis in opposite directions and at different speeds until they meet in a plane inclined from the vertical toward the normal position of the more slowly moving box.

22. A machine of the class described comprising a pair of core boxes, means for swinging one of said boxes through an angle less than ninety degrees and for swinging the second box until it engages and registers with the first and thereafter swinging said first box back to normal position while maintaining the second box in engagement with the first box.

23. A machine of the class described comprising a dumping carrier, a receiving carrier, a core box attached to each carrier, a substantially horizontal shaft constituting a pivotal support for said carriers, the carriers being normally disposed horizontally and at opposite sides of said shaft, means for simultaneously swinging said carriers upwardly until their core boxes are brought into registering engagement, the speed of movement of the dumping carrier being greater than that of the receiving carrier, the movement of the carrier being such, after the core boxes engage, as to swing them as a unit to the normal position of the receiving carrier, the dumping carrier thereafter reversing its movement.

24. A machine of the class described comprising a pair of core boxes normally spaced apart, actuating means for swinging the boxes in opposite directions about a common axis until they meet and register and for thereafter swinging them as a unit toward a horizontal position, and means for resiliently opposing the latter movement.

25. A machine of the class described comprising an oscillatory horizontal shaft, a core box carrier secured to the shaft to turn therewith, a second core box carrier journaled to turn freely on said shaft, said second carrier having an actuating arm, power means for simultaneously turning the shaft and actuating arm in opposite directions, and cushioning means connected to said actuating arm whereby resiliently to oppose movement of the latter in one direction at least.

26. A machine of the class described comprising a pair of core box carriers, a sub-

stantially horizontal shaft constituting a pivotal support for said carriers, the carriers being normally disposed at opposite sides of said shaft, a core box attached to one carrier, a complemental core box mounted upon the second carrier, means for swinging the carriers in opposite directions about said shaft until the core boxes are brought into registering engagement, and for thereafter moving them as a unit toward the normal position of the second carrier, and cushioning means for preventing shock as the second carrier returns to normal position.

27. A machine of the class described comprising a pair of core box carriers, a substantially horizontal shaft constituting a pivotal support for said carriers, the carriers being normally horizontally disposed but at opposite sides of said shaft, a core box attached to one carrier, a complemental core box mounted upon the second carrier, means for simultaneously swinging the carriers upwardly about said shaft until the core boxes are brought into registering engagement and for thereafter moving them as a unit toward the normal horizontal position of one carrier, and a dash pot cylinder having a piston so related to one at least of said carriers as to oppose movement of said carrier.

28. A machine of the class described comprising a pair of core boxes normally spaced apart, actuating means for swinging the boxes in opposite directions about a common axis until they meet and register and for thereafter swinging them as a unit to a horizontal position, and means for locking the boxes together when they meet and for automatically releasing the locking means when the engaging boxes have reached horizontal position.

29. A machine of the class described comprising a pair of core boxes normally spaced apart, actuating means for swinging the boxes in opposite directions about a common axis until they meet and register and for thereafter swinging said boxes as a unit to a substantially horizontal position, a latch for holding said boxes in contact while they are swinging as a unit, and means engageable by said latch as the boxes reach horizontal position for releasing the latch.

30. A machine of the class described comprising a pair of core box carriers, a substantially horizontal shaft constituting a pivotal support for said carriers, the carriers being normally horizontally disposed but at opposite sides of said shaft, a core box attached to one carrier, a complemental core box mounted upon the second carrier, means for swinging said carriers upwardly from normal position until their core boxes meet and register and for thereafter swinging them both toward the normal position of the first carrier, a latch carried by one carrier engageable with the other carrier when they meet to lock them together, and an abutment element adjacent to the normal position of the second carrier for releasing said latch as the second carrier approaches its normal position.

31. A machine of the class described comprising an oscillatory horizontal shaft, a core box carrier secured to the shaft to turn therewith, a second core box carrier journaled to turn freely on said shaft, said second carrier having an actuating arm, and means for turning said shaft and for simultaneously swinging the second carrier in the opposite direction.

32. A machine of the class described comprising an oscillatory horizontal shaft, a core box carrier secured to the shaft to turn therewith, a second core box carrier journaled to turn freely on said shaft, said second carrier having an actuating arm, a drive member, means transmitting motion from said drive member to turn said shaft, means transmitting motion from said drive member to the actuating arm of the second carrier, and means for rendering inoperative said last-named motion-transmitting means.

33. A machine of the class described comprising an oscillatory horizontal shaft, a core box carrier secured to the shaft to turn therewith, a second core box carrier journaled to turn freely on said shaft, said second carrier having an actuating arm, a drive member, gearing for transmitting motion from the drive member to the shaft to turn the latter, means including normally cooperative but disengageable parts for transmitting movement from the drive member to said actuating arm, and means for automatically disengaging said parts at a predetermined point in the operation of the drive member.

34. A machine of the class described comprising an oscillatory horizontal shaft, a core box carrier secured to the shaft to turn therewith, a second core box carrier journaled to turn freely on said shaft, said second carrier having an actuating arm, power means for turning the shaft to swing the first carrier from normal horizontal position, disengageable connections for transmitting movement from the power means to the actuating arm to swing the second carrier upwardly from normal position, means for disengaging said connections before the second carrier has attained a vertical position, and means for retarding the second carrier as it moves back to normal position.

35. A machine of the class described comprising an oscillatory horizontal shaft, a core box carrier secured to the shaft to turn therewith, a second core box carrier journaled to turn freely on said shaft, said second carrier having an actuating arm, power means for turning the shaft to lift the first core box carrier, disengageable connections

for transmitting movement from the power means to the actuating arm whereby to lift the second core box carrier, means for disengaging said connections when the second carrier has been lifted to a predetermined extent, and cushioning means connected to said actuating arm.

36. A machine of the class described comprising an oscillatory horizontal shaft, a core box carrier secured to the shaft to turn therewith, a second core box carrier journaled to turn freely on said shaft, said second carrier having an actuating arm, power means for turning the shaft to swing the first carrier from normal horizontal position, disengageable connections for transmitting movement from the power means to the actuating arm to swing the second carrier upwardly from normal position, means for disengaging said connections at a predetermined point in the movement of the second carrier, and a dash pot cylinder having a piston connected to said actuating arm to oppose the reverse movement of the second carrier.

37. A machine of the class described comprising an oscillatory horizontal shaft, a core box carrier secured to the shaft to turn therewith, a second core box carrier journaled to turn freely on said shaft, said second carrier having an actuating arm, power means for turning the shaft to swing the first carrier from normal horizontal position, disengageable connections for transmitting movement from the power means to the actuating arm to swing the second carrier upwardly from normal position, the relative rates of swing of the carriers being such that the first carrier meets the second before the latter has attained a vertical position, means for disengaging said connections when the carriers meet, and means for retarding the second carrier as it is pushed back to normal position by the continued advance of the first carrier.

38. A machine of the class described comprising an oscillatory horizontal shaft, a core box carrier secured to the shaft to turn therewith, a second core box carrier journaled to turn freely on said shaft, said second carrier having an actuating arm, a fluid actuated piston, a rack bar connected to the piston, gearing transmitting movement from the rack bar to the shaft to swing the first carrier upwardly from normal position, disengageable connections for transmitting movement from the rack bar to the actuating arm to swing the second carrier upwardly from normal position, the relative rates of movement of the carriers being such that they meet before the second carrier has reached a vertical position, means for locking the carriers together when they meet and for disengaging said motion-transmitting connections, and means for resiliently opposing return of the second carrier to normal position.

39. A machine of the class described comprising an oscillatory horizontal shaft, a core box carrier secured to the shaft to turn therewith, a second core box carrier journaled to turn freely on said shaft, said second carrier having an actuating arm, a reciprocating drive member provided with rack teeth, gearing actuated by said rack teeth for turning said shaft, an abutment carried by the reciprocating drive member, a latch link pivotally connected at one end to the actuating arm, the opposite end of the link having a pin normally engaging the abutment, and means for disengaging the pin from the abutment when the drive member reaches a predetermined point in its travel.

40. A machine of the class described comprising an oscillatory horizontal shaft, a core box carrier secured to the shaft to turn therewith, a second core box carrier journaled to turn freely on said shaft, said second carrier having an actuating arm, a reciprocating rack, gearing for transmitting motion from the rack to the shaft, an abutment moving with the rack, a latch normally engaging the abutment and transmitting movement from the latter to the actuating arm, and an adjustable, normally fixed cam for releasing the latch from the abutment when the rack reaches a predetermined point in its travel in one direction.

41. A machine of the class described comprising an oscillatory horizontal shaft, a core box carrier secured to the shaft to turn therewith, a second core box carrier journaled to turn freely on said shaft, said second carrier having an actuating arm, a drive member, gearing for transmitting movement from the drive member to the shaft, a link connected to said actuating arm, an abutment moving with the drive member and normally engaging said link whereby to operate the actuating arm, and a cam for disengaging the link from said abutment at a predetermined point in the operation of the drive member.

42. A machine of the class described comprising a dumping carrier, a receiving carrier, a core box attached to each carrier, a substantially horizontal shaft constituting a pivotal support for said carriers, the carriers being normally disposed horizontally and at opposite sides of said shaft, means for swinging the carriers upwardly in opposite directions until their core boxes are brought into registering engagement, the speed of movement of the dumping carrier being greater than that of the receiving carrier so that the boxes meet in a plane inclined to the vertical, means for disconnecting the receiving carrier from its actuating means after the core boxes meet, the receiving carrier then returning to normal position and the dumping carrier following it, keeping the core boxes in contact, and means for there-

after restoring the dumping carrier to normal position.

43. In a core booking machine, a stationary support, complementary core box parts mounted on said support for movement between filling and booking positions, and means unconnected with said parts but engageable therewith for moving said parts together at a booking position and for thereafter moving said parts together to one of said filling positions.

44. In a core booking machine, a support, complementary core box parts connected to said support for movement between a separated position and a booked position; and means for moving said parts from said separated position to said booking position, said booking position being inclined from the vertical position.

45. In a core booking machine, a support, complementary core box parts connected to said support for movement between a separated position and a booking position, and fluid operated means for moving said parts from said separated position to said booking position said booking position being inclined from the vertical.

46. In a core box booking machine, a support complementary halves of a core box mounted on said support and relatively pivotally connected together for swinging movements toward and from a booking position, from and toward a substantially horizontal filling position, and means for swinging one of said halves about its pivot past vertical dead center of the half with respect to the pivot.

47. In a core box booking machine, complementary halves of a core box relatively hinged together at one side of each, means for supporting said halves in substantially horizontal open position, and means for moving one of said halves about said hinge and away from said support to book the halves together, said means moving said half past its vertical dead center with respect to said hinge.

48. In a core booking machine, a support, complementary halves of a core box mounted on said support and relatively pivotally connected together for swinging movements toward and from a booking position from and toward a substantially horizontal filling position, and fluid operated means for swinging one of said halves about its pivot past vertical dead center of the half with respect to the pivot.

49. In a core booking machine, complementary halves of a core box relatively hinged together at one side of each, means for supporting said halves in substantially horizontal open position, and fluid operated means for moving one of said halves about said hinge and away from said support to book the halves together, said means moving said half past its vertical dead center with respect to said hinge.

Signed by me at Westfield, Massachusetts, this thirteenth day of January, 1927.

CLARENCE K. PRINCE.