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3,416,203

AUTOMATIC APPARATUS WITH CONTINUOUSLY MOVING CONVEYORS  
FOR CASTING CERAMIC ARTICLES

Filed June 17, 1964

7 Sheets-Sheet 1

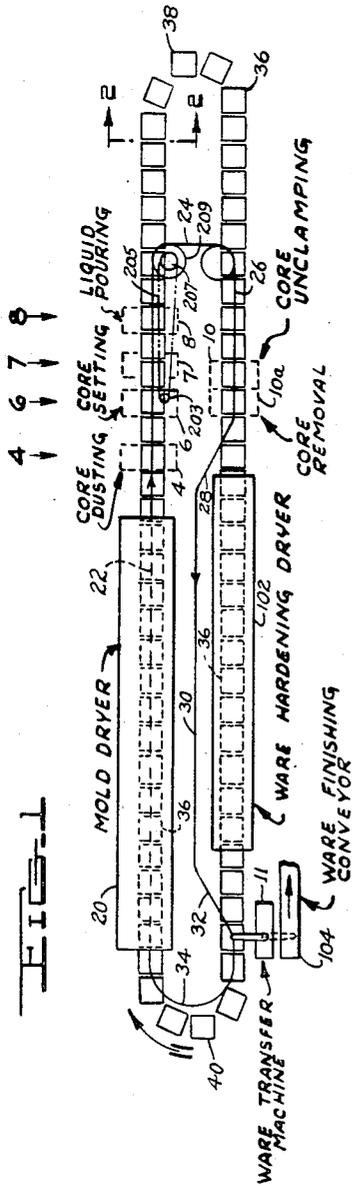
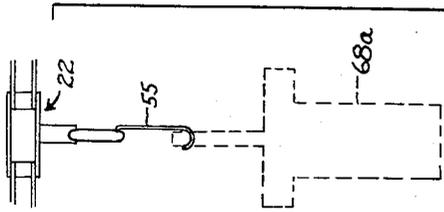


FIG. 1

FIG. 2

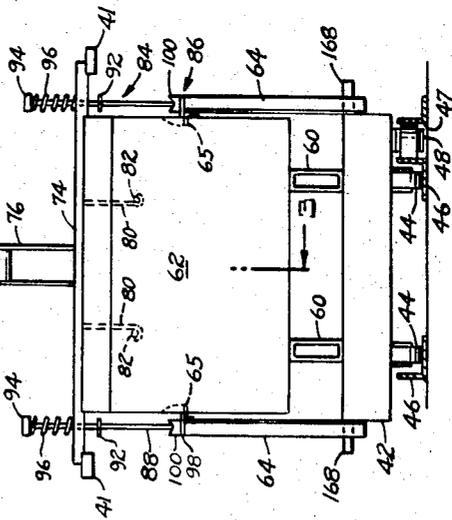
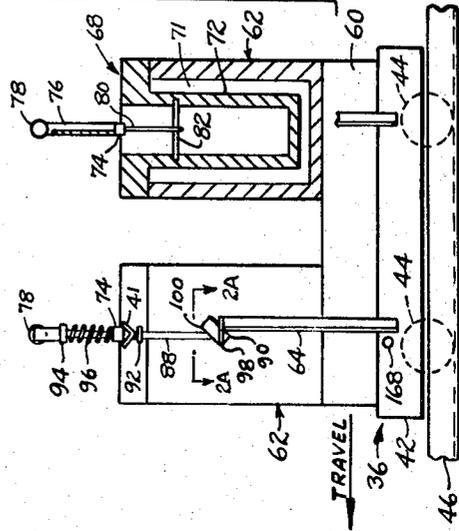
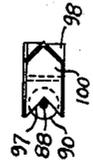


FIG. 2A



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FIG. 4

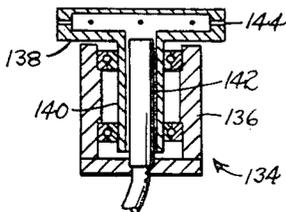
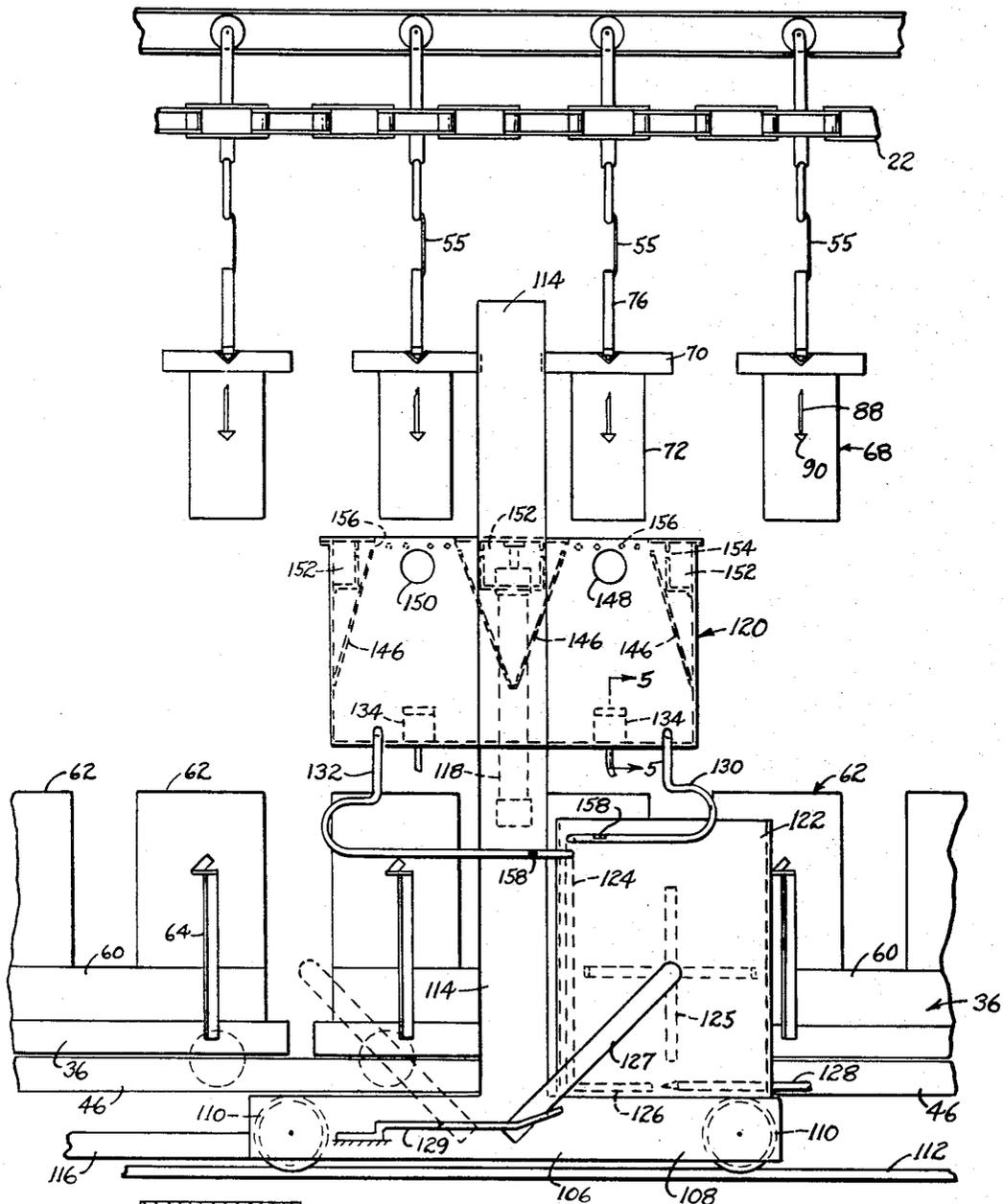


FIG. 5

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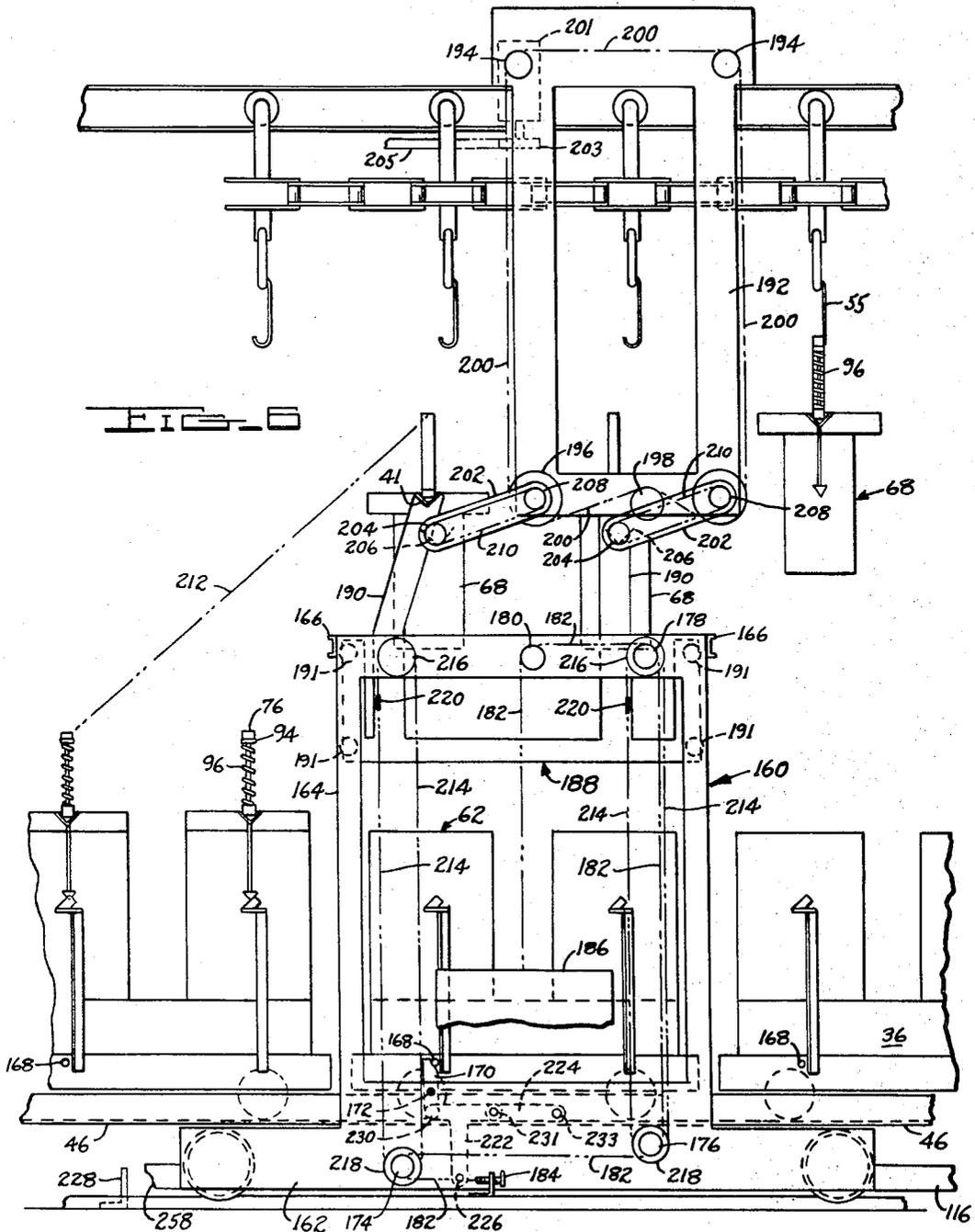
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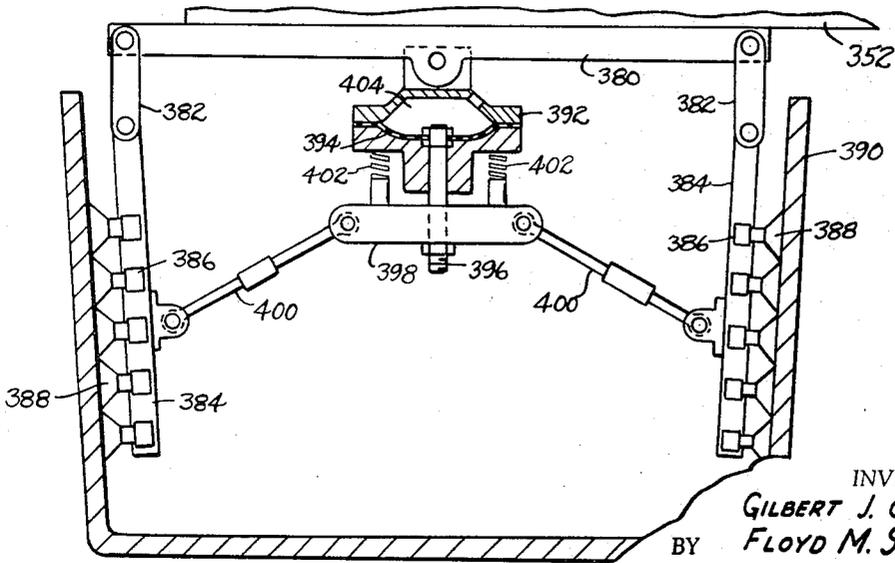
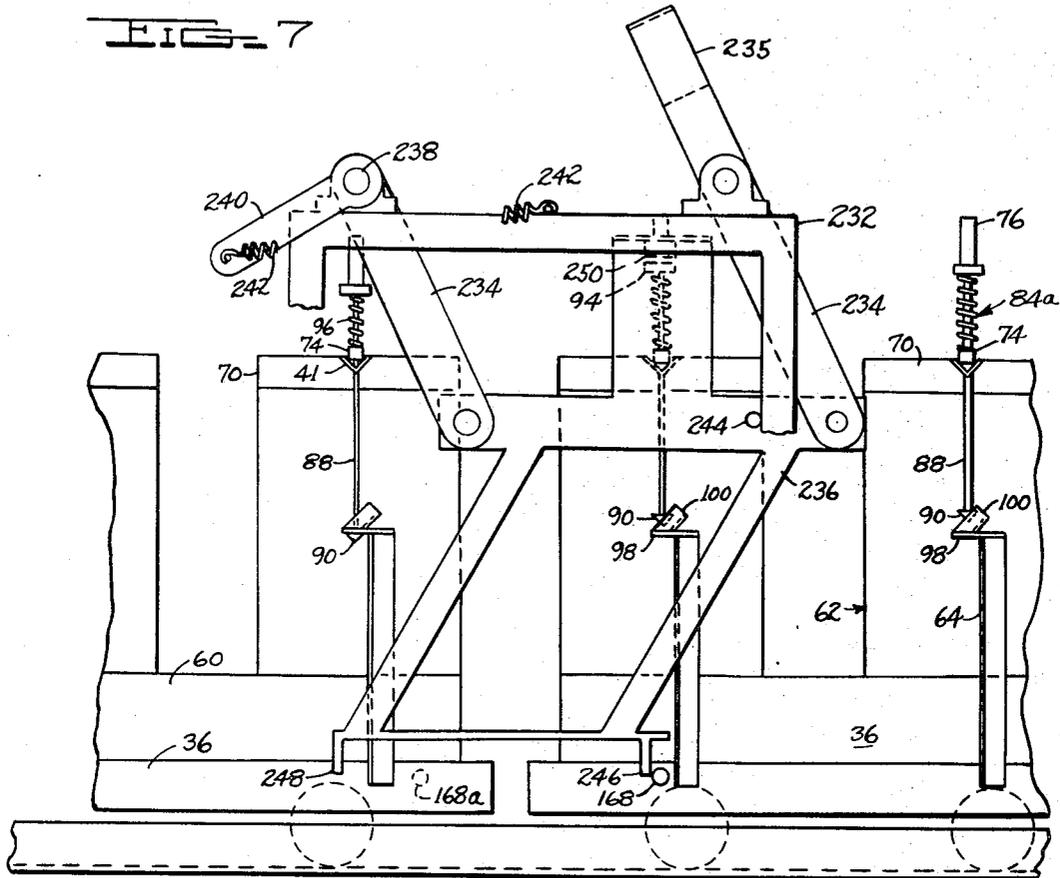
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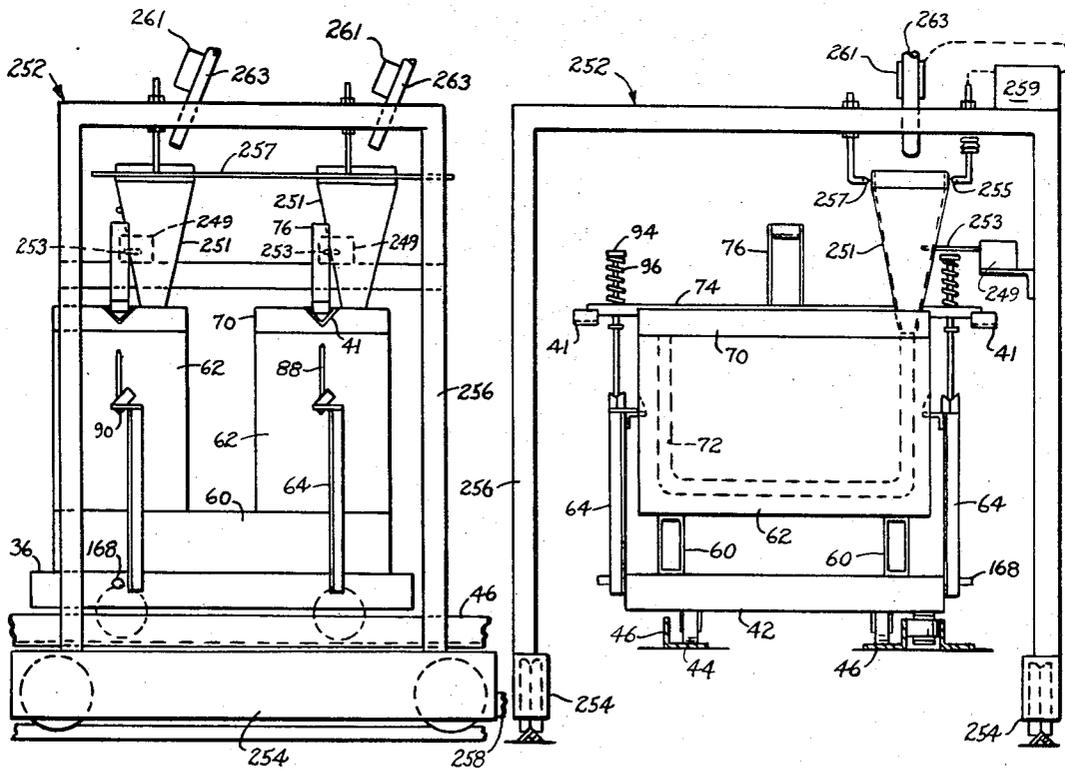
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FIG. 8

FIG. 9



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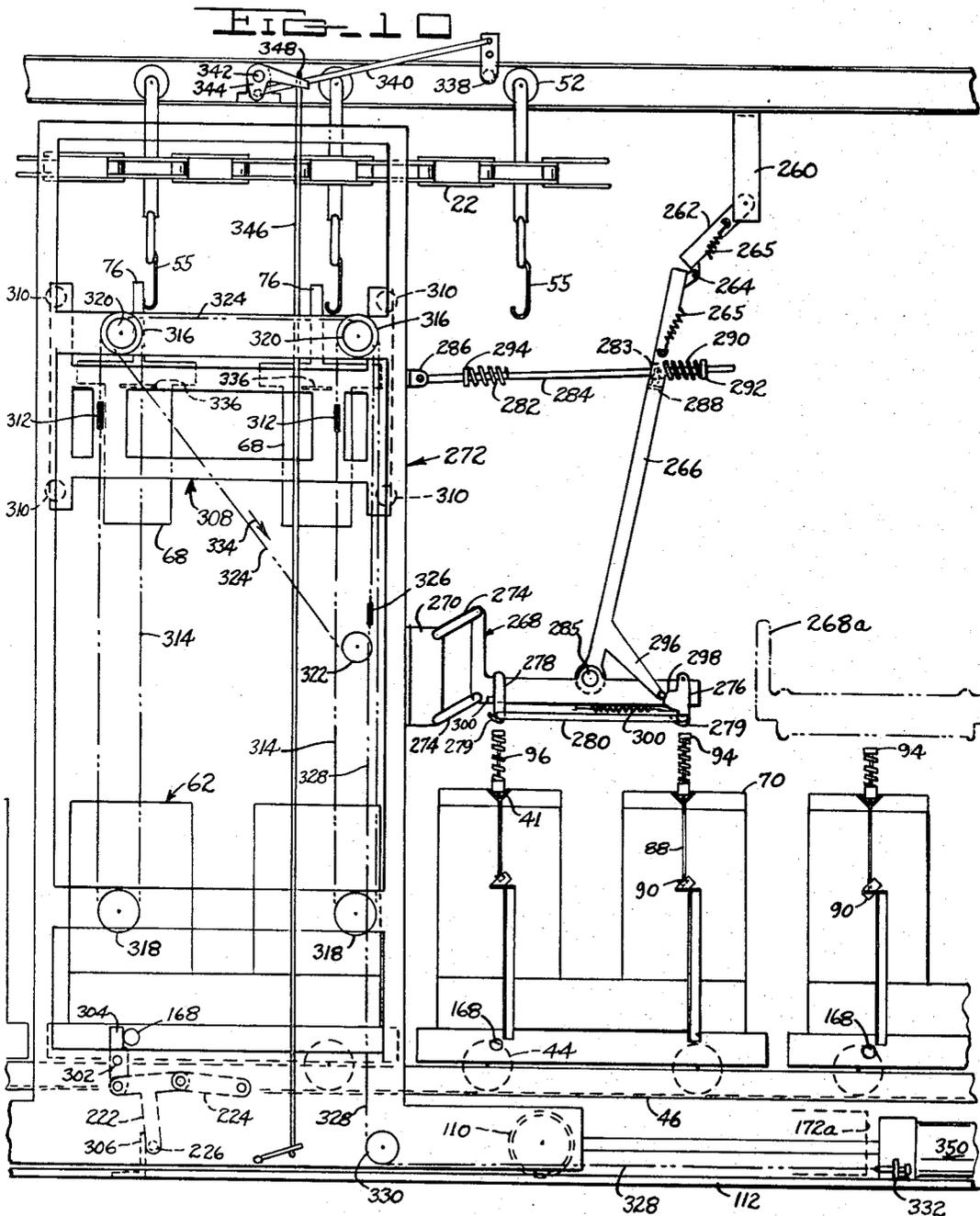
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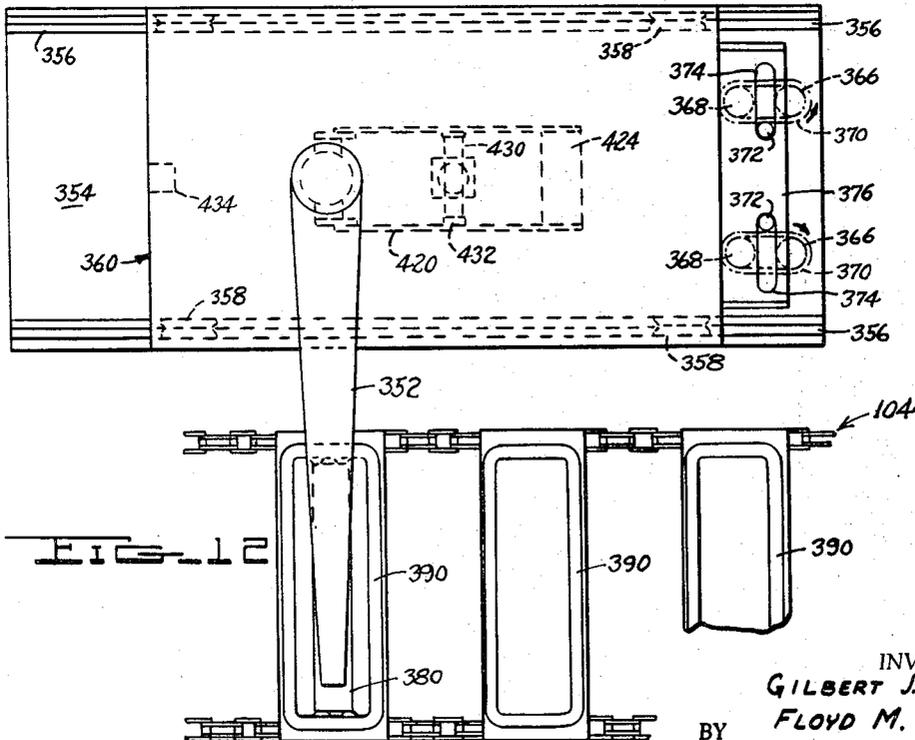
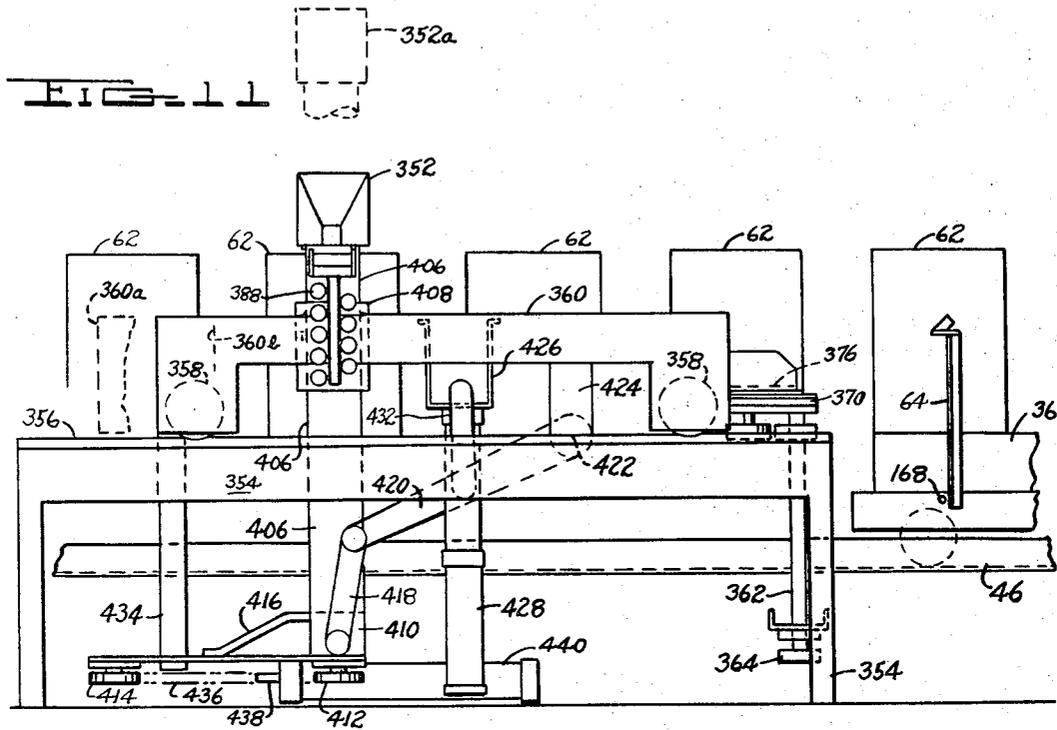
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**AUTOMATIC APPARATUS WITH CONTINUOUSLY MOVING CONVEYORS FOR CASTING CERAMIC ARTICLES**

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 Filed June 17, 1964, Ser. No. 375,892  
 14 Claims. (Cl. 25—29)

This invention relates to apparatus for casting articles, for example ceramic articles such as water closet tanks. In some respects the invention is an improvement on the method and apparatus claimed in U.S. application Ser. No. 361,847, filed Apr. 22, 1964, in the names of A. J. Arnold, B. Van Dyke, D. Van Dyke and D. D. Porter also owned by the instant assignee.

In the apparatus and method of said application casting operations are performed with mated male and female plaster mold members which are at times supported separately on an endless overhead conveyor and an endless lower conveyor. The conveyors run through a tunnel drier which heats the mold members to remove moisture accumulations therein, after which talc or other powdered mold release material is applied to the male mold member. The heated mold members are then automatically mated and clamped together on the lower conveyor to define mold cavities, and liquid casting material is thereafter poured into the cavities.

The mated mold cavity members are then conveyed by the lower conveyor without otherwise being disturbed, during which time the liquid casting material gives up the major portion of its moisture to the plaster mold members; the casting material thus assumes a soft semi-rigid state in the mold members.

At the conclusion of the casting period the male cavity members or casting cores are transferred from the cast articles back to the overhead conveyor, and the cast articles and female mold cavity members are conveyed on the lower conveyor through a second tunnel drier to harden the cast article. Thereafter each rigid hardened article is automatically transferred from its female mold cavity member to a finishing conveyor where the article is inspected and any imperfections therein removed manually.

It is an object of the present invention to simplify the method and apparatus disclosed in the aforementioned patent application. More particularly, it is an object to provide a casting apparatus in which the mold cavity members and casting cores are moved continuously without the stop and go movement which characterizes the apparatus disclosed in the aforementioned application. The proposed arrangement thus minimizes wear on the apparatus components.

A further object of the invention is to provide a casting apparatus which employs a minimum number of fluid cylinders, electrical components and other devices subject to high initial and maintenance costs.

An additional object is to provide a casting apparatus wherein the conveyors for the mold members are driven from a single power means, whereby the conveyors are accurately timed relative to one another.

A still further object is to provide a casting apparatus wherein the main conveyors are used to power various machines located at spaced points therealong. The arrangement thus automatically synchronizes the machines with respect to the travelling mold cavity members irrespective of such factors as differential thermal expansions in the conveyor components, or manufacturing tolerance variations in the conveyor components.

Other objects of this invention will appear from the following description, accompanying drawings, and ap-

ended claims, reference being had to the accompanying drawings forming a part of this specification wherein like reference characters designate corresponding parts in the several views.

In the drawings:

FIGURE 1 is a schematic plan view of a casting apparatus incorporating features of the invention therein;

FIG. 2 is an enlarged view taken on line 2—2 in FIG. 1 illustrating a conveyor and mold cavity member supported thereon;

FIG. 2A is an enlarged sectional view taken on line 2A—2A in FIG. 3;

FIG. 3 is a side elevational view of the FIG. 2 conveyor and mold cavity member with parts thereof sectioned on line 3—3;

FIG. 4 is an enlarged side elevational view of a machine for applying mold release powder to male casting cores employed in the FIG. 1 apparatus. The view is taken substantially along the line of arrow 4 in FIG. 1;

FIG. 5 is an enlarged sectional view of a rotary powder spray means employed in the FIG. 4 machine. The view is taken substantially on line 5—5 in FIG. 4;

FIG. 6 is a side elevational view of a machine employed in the FIG. 1 apparatus for transferring casting cores from a continually moving overhead conveyor into mold cavity members located on a continually moving lower conveyor. The figure is taken generally along the line of arrow 6 in FIG. 1;

FIG. 7 is an enlarged side elevational view of a machine employed in the FIG. 1 apparatus for clamping male casting cores on mold cavity members as the cores and cavity members are being moved along on the aforementioned lower conveyor. The figure is taken substantially in the direction of arrow 7 in FIG. 1.

FIG. 8 is an enlarged side elevational view of a machine employed in the FIG. 1 apparatus for automatically pouring liquid casting material into the mold cavities defined by the aforementioned clamped casting cores and mold cavity members. The figure is taken substantially in the direction of arrow 8 in FIG. 1;

FIG. 9 is a right end view of the FIG. 8 machine;

FIG. 10 is an enlarged side elevational view of a machine employed in the FIG. 1 apparatus for unclamping casting cores from mold cavity members, and for transferring the unclamped cores to the aforementioned continually moving upper conveyor;

FIG. 11 is an enlarged side elevational view of an article transfer machine shown at 11 in FIG. 1;

FIG. 12 is a top plan view of the FIG. 11 machine;

FIG. 13 is an elevational view of an article-gripper mechanism employed in the FIG. 11 machine.

Before explaining the present invention in detail, it is to be understood that the invention is not limited in its application to the details of construction and arrangement of parts illustrated in the accompanying drawings, since the invention is capable of other embodiments and of being practiced or carried out in various ways. Also, it is to be understood that the phraseology or terminology employed herein is for the purpose of description and not of limitation.

In the drawings, particularly FIGS. 2 and 3, there is shown a carrier 36 comprising a rectangular base 42 mounted on four wheels 44 which run on angle iron tracks 46. The carrier is suitably attached to a powered endless chain 48 which runs in a trackway 47 to move the carrier along tracks 46.

Carrier 36 comprises two longitudinally extending bars 60 which form supporting surfaces for a pair of transversely extending female plaster mold cavity members 62. To fixedly retain the plaster mold cavity members in position there are provided four upstanding angle irons 64,

each having an adjustable hold-down member 65 extending into an external recess in a side surface of the mold cavity member.

Removably associated with each mold cavity member 62 is a male plaster casting core 68 having an upper flange portion 70 adapted to rest on the upper edge of the mold cavity member, and having a depending portion 72 adapted to nest within the mold cavity member to cooperate therewith in forming a mold cavity 71.

During certain periods in the casting operation casting cores 68 are suspended on an overhead conveyor in dotted line position 68a (FIG. 3); for suspension purposes the core is provided with an elongated rectangular bar 74 nesting within notches in the core upper face, and tied down by links 80 which engage pins 82 embedded in core 68 at the time of its formation. Bar 74 is secured to an upstanding channel 76 having a circular pin 78 mounted therein. It will be seen that core 68 can be suspended in an elevated position above mold cavity member 62 when its pin 78 is supported in the hook 55 of an overhead conveyor 22. Transfer of the casting core between its FIG. 3 full line and dotted line positions is accomplished by suitable machines not visible in FIGS. 2 and 3; V-shaped walls 41 are provided on bar 74 to seat in suitable sockets provided in such machines.

During certain periods in the casting operation it is necessary that core 68 be clamped tightly against mold cavity member 62. To provide the clamping action members 62 are equipped with detent structures 86, and members 68 are equipped with latch structures 84. Each latch structure 84 comprises a rod 88 having a conical enlarged head 90 at its lower end, an enlarged stop 92 at its midpoint, and an enlarged head 94 at its upper end. Each rod 88 is slidably mounted for vertical movement in bar 74 under the biasing action of a compression spring 96.

Each detent structure 86 takes the form of a horizontal plate 98 secured to the upper end of angle iron 64, and an upwardly angling V-cross section guide wall 100 which leads to a notch 97 in plate 98. By applying a downward force on head 94 rod 88 can be forced downwardly to move latch head 90 downwardly along wall 100 and through notch 97, whereby the head engages the underside of plate 98 and thereby loads the spring 96 to apply the necessary force for clamping core 68 on cavity member 62. Preferably the latching operation is performed automatically by a mechanically derived downward force applied by the FIG. 7 machine.

Referring now to FIG. 1, there is shown an apparatus which comprises a tunnel drier 20 having the aforementioned upper and lower endless conveyors 22 and 48 running therethrough. The upper conveyor proceeds left to right in drier 20 and travels some distance rightwardly before turning as indicated by numeral 24. It then turns again and proceeds leftwardly as indicated at 26, then angularly as indicated at 28, leftwardly as indicated at 30, angularly as indicated at 32, and clockwise at 34 before again entering drier 20.

The lower conveyor, which includes a plurality of the aforementioned carriers 36 connected together by the endless chain 48, proceeds rightwardly through drier 20 and for a considerable distance therebeyond before making a reverse clockwise turn, as at 38. Carriers 36 then proceed leftwardly through an article hardening drier 102 before making a clockwise reverse turn at 40 preparatory to entering mold drier 20.

Preferably both chains of the upper and lower conveyors are driven from a single power source such as an electric motor (not shown). The drive may consist simply of a vertical shaft provided with chain-engaged sprockets adjacent its upper and lower ends. Under the preferred arrangement the motor is operated continually, and the conveyors therefore run at all times at the same speed without stop-and-go movement.

Still referring to FIG. 1, conveyor 22 carries a line of the aforementioned casting cores from drier 20 through a

dusting or powder-applying machine 4 which automatically applies talc or other mold release powder to the depending surfaces of the cores. As the cores are further conveyed rightwardly from drier 20 they are automatically lowered into travelling mold cavity members on carriers 36 by the core setting machine shown diagrammatically at 6 in FIG. 1.

As the mold cavity members are further moved rightwardly the aforementioned latches 84 are automatically engaged with the aforementioned detents 86 by a clamping machine illustrated diagrammatically at 7 in FIG. 1. Further rightward movement of the mold cavity members brings them into the liquid pouring machine illustrated diagrammatically at 8 in FIG. 1. In this machine predetermined quantities of liquid casting material are poured into the mold cavities defined by the mated casting cores and mold cavity members.

From the pouring machine the mold cavity member assemblies are directed rightwardly, then around turn 38, and then leftwardly to a core unclamping machine illustrated diagrammatically at 10. During the time required to travel from pouring machine 8 to clamping machine 10 (on the order of one hour) the casting liquid gives up moisture to the heated mold members, whereby to assume a semi-hardened condition.

Core unclamping machine 10 is associated with a core removal machine 10a which operates to automatically lift the unclamped cores from the now partially hardened cast article, and to transfer the lifted cores onto the overhead conveyor 22. As illustrated in FIG. 1, the overhead conveyor makes a jog at 28, then travels leftwardly at 30, then makes a reverse jog at 32, before making a clockwise turn at 34 preparatory to entering the mold drier 20.

The mold cavity members 62 (having the cast articles therein) proceed leftwardly from core removal machine 10a through article hardening drier 102 to a transfer machine 11 which operates to automatically lift the cast articles from the mold cavity members, and to deposit them onto a ware finishing conveyor 104. The ware finishing conveyor in the illustrated apparatus is intended to operate at the same speed as the upper and lower conveyors 22 and 36, but in the reverse direction. It permits the cast articles to be inspected, trimmed, and repaired where necessary.

With the above brief description in mind, the details of each of the cooperating machines will be now described.

#### *Core dusting machine (FIG. 4)*

This machine includes a carriage 106 having spaced-apart base members 108 mounted on four grooved wheels 110 which run on two V-tracks 112. The carriage also comprises two spaced-apart upstanding arms 114 located outboard of the aforementioned conveyors 20 and 35 to permit carriage 106 to travel longitudinally without interfering with the movement of the conveyors or their contents. In its FIG. 4 position carriage 106 is in its rightmost position. At a suitable time in the operating cycle it begins to move to the left in synchronism with the upper and lower conveyors 22 and 36; this leftward movement is effected by means of a tow bar 116 which is attached to a travelling core setting machine to be described in detail hereinafter.

Upstanding arms 114 of carriage 106 mount two air cylinders 118, which have their pistons connected with suitable brackets carried by a rectangular dust or powder box 120. The cylinders are energized automatically during the leftward movement of carriage 106 to elevate box 120 to a position encircling the depending portions 72 on the superjacent casting cores 68. After the powder box has been thus elevated powdered talc or other mold release material is automatically swirled onto portions 72.

To initially supply the powder carriage 106 is provided with a rectangular open-topped talc container 122. A suction tube 124 projects downwardly into the container and then laterally at 126 into registry with an air jet tube 128,

which is operated at predetermined times in the operating cycle to blow powder into tube portions 126 and 124. To prevent caking or lumping of the powder, container 122 is equipped with a rotary bladed stirrer 125 which is attached to arm 127. During back-and-forth movement of carriage 106 the lower end of arm 127 is loosely retained in a slot in a fixed bar 129; accordingly the arm is shifted between its full and dotted line positions to thereby rotate stirrer 125 for preventing undesired caking of the talc.

Tube 124 connects with flexible tubes 130 and 132, which in turn connect with portions of box 120. Mounted on the bottom wall of box 120 are two powder distributors 134, each comprising a fixed mounting structure 136 and a rotary head 138 having a downwardly extending tubular member 140 encircling a fixed air introduction tube 142. Head 138 is provided with a series of circumferentially spaced discharge openings 144 which are preferably obliquely angled with respect to the radius of the head, whereby the introduction of compressed air into the lower end of tube 142 causes a rotary motion to be imparted to head 138. The air is discharged through openings 144 and causes the powder in box 120 to be swirled upwardly against peripheral baffles 146 located in box 120. The powder is initially introduced into box 120 by vacuum force.

The vacuum force is preferably derived from a remotely located blower which applies the vacuum force through four large tubes. Two of the tubes connect with opposite side surfaces of box 120 in the area generally designated by openings 148, and the other two tubes connect with opposite surfaces of box 120 in the area generally designated by openings 150. Openings 148 draw powder onto the rightmost casting core 68, and openings 150 draw powder onto the leftmost casting core 68. The blower preferably runs continuously, but it is effective only when cylinders 118 have elevated box 120 upwardly to engage core flanges 70.

Preferably the blower tubes communicate with peripheral channels 152 having small openings 154 communicating with circumferentially spaced openings 156 in baffles 146. Therefore when powder box 120 is in its elevated position flange portions 70 on the casting cores seal the main openings in box 120, and the blower cooperates with the swirling jets from distributors 134 to swirl powder from the lower portions of box 120 onto the surfaces of core portions 72; some of the powder adheres to the core and some is drawn through openings 156, channels 152, and the tubes connected with openings 148 and 150.

Tubes 130 and 132 are preferably provided with adjustable size openings 158 which regulate the quantity of powder supplied to box 120. As will be apparent, reducing the size of openings 158 causes more powder to be supplied, and increasing the size of openings 158 causes less powder to be supplied.

The aforementioned tow bar 116 correlates the movement of carriage 106 with that of cylinders 118 so that the carriage starts its slow leftward motion in synchronism with casting cores 68 before cylinders 118 are energized. Box 120 is thus moved upwardly by cylinders 118 without halting the overhead conveyor 22 or interfering with the movement of cores 68. While box 120 is in its elevated position high velocity air is fed through tube 128 for a short period of time (e.g., ten seconds) to supply powder to tube 124. The aforementioned blower means then draws the powder onto the surfaces of core portions 72.

At a suitable point in the operating cycle (with carriage 106 still moving leftwardly) cylinders 118 are actuated to lower box 120 to its illustrated position. Thereafter carriage 106 is quickly moved rightwardly to its illustrated position by the aforementioned tow bar 116. The start and finish positions of the carriage correspond with the two illustrated positions of arm 127.

### Core setting machine (FIG. 6)

The core setting machine comprises a carriage 160 having a pair of laterally spaced base members 162 and upstanding portions 164 which may be connected by cross members 166. Upstanding portions 164 are located outboard of tracks 46 to permit carriage 160 to move longitudinally without interfering with the moving carriers 36 or the mold cavity members supported thereon. The carriage is illustrated in its rightmost start position just preparatory to being moved leftwardly by one of the carriers.

Leftward movement of carriage 160 is effected through pins 168 extending from each carrier 36, and retractable arms 170 pivotally mounted at 172 on the carriage. Arms 170 are pivotally connected at 230 with bell crank members 222 which are in turn pivotally connected at 231 with links 224 which are pivoted at 233 on carriage 160. The two bell cranks 222 are interconnected by means of a transverse rod 226 which is arranged in horizontal registry with a fixed upstanding abutment 228.

During service carrier pins 168 strike arms 170 to drive carriage 160 slowly leftwardly until rod 226 strikes fixed abutment 228. As the rod strikes abutment 228 it causes bell crank 222 to swing in an upward counterclockwise arc about pivot connection 230, thereby causing itself and link 224 to buckle upwardly about pivot 233. Pins 168 thus force arms 170 to be drawn counterclockwise about pivot pins 172, and thus retracted downwardly away from pins 168. Weights 186 (described later) are thereby effective to return carriage 160 rightwardly to its illustrated position. This rightward movement is fairly rapid, and takes place in a very few seconds. To cushion this movement there is preferably provided a fluid cylinder (not shown), having its cylinder and piston portions connected respectively with the carriage and a non-illustrated fixed support structure.

Rotatably mounted on the carriage 160 are sprockets 174, 176, 178 and 180 having chains 182 trained therearound. One end of each chain is connected with a fixed anchorage at 184, and the other end is connected with a weight 186 which is suitably supported for vertical movement on the carriage. As carriage 160 is drawn leftwardly weights 186 are raised; after a predetermined leftward movement of the carriage weights 186 (now elevated) are effective to drive the carriage rightwardly back to its illustrated start position. During this rightward movement the aforementioned core dusting machine, and the liquid pouring machine (to be described hereinafter) are automatically returned to their start positions.

Mounted for vertical movement in carriage 160 are parallel elevators 188 having two pairs of upstanding arms 190 affixed thereto. The upper ends of these arms are formed to provide V-seats for cradling the V-shaped portions 41 on bars 74 of the overhead casting cores 68. Diagrammatically illustrated rollers 191 are provided to guide the elevators for vertical movements in carriage 160. Elevators 188 are located in their most elevated positions when carriage 160 is in its FIG. 6 start position. As the carriage is drawn leftwardly (by carrier 36) each elevator is gradually lowered to lower the supported casting cores 68 into the superjacent mold cavity members along the directional line denoted generally by numeral 212. To effect and control the lowering motion of elevators 188 there are provided four endless chains 214 trained around upper carriage-mounted sprockets 216 and lower carriage-mounted sprockets 218. Sprockets 218 are rigid with the aforementioned sprockets 174 and 176; chains 214 are anchored to elevators 188 by means of anchorages 220. Therefore as carriage 160 moves leftwardly sprockets 174 and 176 are rotated counterclockwise and clockwise respectively, whereby the attached sprockets 218 cause chains 214 to effect a controlled lowering of elevators 188. This lowering movement takes place while the carriage is moved leftwardly so that the supported casting cores move downwardly and also left-

wardly along the directional line 212. As a result, the cores are lowered into the subjacent mold cavity members 62 located on travelling carrier 36.

The mechanism for initially transferring the casting cores from overhead conveyor 22 to elevators 188 comprises a fixed rectangular framework 192, which mounts upper sprockets 194 and lower sprockets 196 and 198. Trained around these sprockets are endless chains 200. The drive for chains 200 preferably comprises a gear box 201 having its input connected with a sprocket 203 and its output connected with the leftmost sprockets 194. A drive chain 205 may be trained around sprocket 203 and a second sprocket 207 (FIG. 1) connected with the overhead conveyor sprocket 209. The arrangement is designed to cause chains 200 to move at a speed which is proportional to the speed of conveyor 22.

Sprockets 196 are affixed to the pivot shafts for parallel arms 202 so that movement of chains 200 causes arms 202 to continuously rotate counterclockwise about the axes of sprockets 196. The outer or free ends of arms 202 carry small sprockets 204 which are affixed to V-shaped seat elements 206. Cooperating with sprockets 204 are second sprockets 208 and endless chains 210 trained therearound. Sprockets 208 and affixed to framework 192 so that rotary movement of arms 202 causes chains 210 to rotate sprockets 204. The sprocket rotation is effective to maintain the V-seats 206 in upright conditions throughout the rotary movement of arms 202.

In the 2 o'clock position of arms 202 V-seats 206 engage the V bars 41 on the advancing casting cores suspended by hooks 55 and thus lift the casting cores from the continually moving overhead conveyor. Arms 202 move in synchronism with one another so that two casting cores are lifted from the conveyor simultaneously. The overhead conveyor continues to move slowly, while arms 202 continue their counterclockwise rotation at a faster linear speed. At about the nine o'clock position arms 202 pass downwardly by the arms 190 on elevator 188, whereupon the casting cores are transferred to arms 190.

The overall cycle for the core setting machine is initiated as arms 202 deposit casting cores 68 on elevator arms 190. Arms 202 continue to move downwardly while carrier 36 begins to impart horizontal movement to carriage 160 via pins 168 and arm elements 170. As the carriage moves leftwardly its sprockets 218 are rotated by the affixed sprockets 174 and 176 (which are rotated by the relative motion between the carriage and chain anchorage point 184). Rotation of sprockets 218 effects a controlled lowering of elevator 188, whereby the supported cores 68 are lowered into the subjacent travelling mold cavity members 62; the absolute motion of the cores follows directional line 212.

As the carriage reaches a predetermined finish position rod 226 strikes abutment 228 to disengage elements 170 from pins 168, whereupon weights 186 (now elevated) quickly drive the carriage rightwardly back to its illustrated start position. During this rightward movement sprockets 174 and 176 are automatically rotated to cause the attached sprockets 218 to raise the elevator to its illustrated start position.

While the carriage has been moving leftwardly the continuously rotating transfer arms 202 have been moving counterclockwise to lift the next two cores 68 from overhead conveyor 22. By the time carriage 160 has been returned rightwardly to its start position the transfer arms 202 are moving downwardly to deposit the cores in arms 190. After the cores have thus been transferred the pins 168 on the next carrier 36 strike the carriage arm elements 170 to restart the cycle.

#### Core clamping machine (FIG. 7)

The illustrated clamping machine comprises a fixed framework 232 straddling the tracks 46 which support carriers 36 for the mold cavity members 62. Two pairs

of arms 234 are swingably mounted on upper portions of framework 232 with their lower ends pivotally connected to horizontally movable carriages 236. The rotary shaft 238 for the leftmost arms 234 also carries an arm 240 which connects with one end of a tension spring 242. The other end of the spring connects with a fixed anchorage on framework 232, whereby to normally bias arms 234 and carriages 236 to their illustrated start positions. A pin 244 or similar abutment structure may be provided on each carriage 236 to limit the rightward movement of the carriage.

It will be noted that carriages 236 carry depending members 246 and 248. A carriers 36 move along tracks 46 pins 168 strike members 246 causing carriages 236 to move leftwardly in a downward arc. The carriages are provided with two spaced pressure members 250, which when pins 168 strike member 246, are positioned slightly leftwardly of the axes defined by rods 88. Carriages 236 have a horizontal motion component which is the same as the motion of carriers 36; hence pressure members 250 maintain their initial relationships with latch heads 94 while pressing downwardly thereagainst. As a result, the latches are depressed to cause the latch heads 90 to move downwardly through the aforementioned notches 97 provided in detent plates 98. Because members 250 are slightly leftward of the rod 88 axes the rods tend to take tilted positions with heads 90 slightly to the right of heads 94. Latch heads 90 thus tend to snap to the right into engagement with plates 98 after they have passed through notches 97.

When pin 168 reaches dotted line position 168a the pressure members 250 will have risen from heads 94, and the depending member 246 will start to slide rightwardly over pins 168 under the biasing action of spring 242. Carriages 236 will therefore return to the illustrated start position in which pins 168 register with depending members 248. As soon as pins 168 strike members 248 carriages 236 again move leftwardly in the manner previously described; during this movement the next latch assemblies (designated by numeral 84a in FIG. 7) are moved by members 250 to the latched positions.

It will be seen that members 246 and 248 are alternately operative, i.e., members 246 will be engaged with pins 168 during one latching cycle and members 248 will be engaged with the same pins 168 during the succeeding latching cycle.

Preferably carriage 236 is suitably controlled by a counterweight 235 carried by the rightmost arms 234, and a cushioning cylinder (not shown), connected between the hidden arm 240 and framework 242 so that during movement of carriage 236 to its start position the cylinder exerts a speed-retarding action. Counterweight 235 exerts a retarding force during the initial stages of the return movement and an assisting force during the final stages to compensate for the varying force obtained from spring 242.

#### Liquid pouring machine (FIGS. 8 and 9)

The machine for pouring liquid casting material into the mold cavities comprises a carriage 252 consisting of two spaced base members 254 and a frame structure 256 upstanding therefrom. As shown fragmentally in FIG. 8, base structures 254 are provided with pusher bars 258 which connect with the FIG. 6 core setting machine. The carriage 252 therefore moves in synchronism with carriage 160 (FIG. 6) to thus keep pace with the advancing mated core and mold cavity members.

The flange portion 70 of each casting core is provided with an opening for manual reception of a rubber funnel 251. As carriers 36 advance into carriage 252 the funnels engage deflectable arms 253 of switches 249 which control the pouring mechanisms to be described hereinafter. If funnels are inadvertently not positioned in both of the pour openings the pouring mechanism will not be

energized. If only one pour opening has a properly oriented funnel then only that funnel will receive liquid.

To terminate the liquid pouring operation there is preferably provided a capacitance type liquid level detector comprising two longitudinally extending bars 255 and 257. Bar 257 is grounded to carriage 252, and bar 255 is electrically connected with a conventional capacitance level controller 259, which may for example be the commercially trademarked control supplied by the Robertshaw Fulton Company under its designation "No. 102-W Level-Tek." Controller 259 is in turn connected with pneumatically-controlled or electrically-controlled valves 261 which are associated with the liquid pouring conduits 263 mounted on carriage 252.

The space between conductive rods 255 and 257 is occupied by the di-electric funnels 251, whereby an unfilled funnel gives a relatively high capacitance across the space between the rods, and a liquid-filled funnel produces a materially lower capacitance across the space between the rods. The arrangement is used to terminate the liquid pouring operation when the funnel is completely filled.

Preferably the liquid supply pressure is correlated with the stroke of carriage 252 so that liquid is being poured for a substantial portion of the time required for the carriage to move leftwardly from its start position. The liquid can thus be introduced slowly to avoid air entrapment in the mold cavities, and to avoid the necessity for weep holes in the plaster mold members.

During the curing period (the time required for each filled cavity to travel from the liquid pouring machine to the core unclamping machine of FIG. 10) the moisture in the casting material is released to the plaster mold cavity members and casting cores, and the casting material thus tends to shrink. The liquid in funnels 251 provides a reserve supply of casting material for insuring a satisfactory cast article.

#### *Core unclamping and core removal machines (FIG. 10)*

The core unclamping machine comprises a rigid support 260 for pivotally mounting two parallel links 262, which are in turn pivotally connected at 264 with two parallel arms 266. The lower ends of arms 266 are in turn pivotally connected with a carriage 268 comprised of two parallel L-shaped members. A bracket 270 (mounted on the movable carriage 272 of the core removal machine) is interconnected with carriage 268 by means of four parallel links 274, whereby back and forth movement of carriage 272 is effective to shift carriage 268 between its full line position and its dotted line positions 268a. As in the case of the core setting machine of FIG. 6, carriage 268 is arranged to move leftwardly from the dotted line start position to the full line finish position at a relatively slow speed in synchronism with the mold cavity members on the lower conveyor, and to move rightwardly with carriage 272 to the start position at a relatively fast speed.

Pivotally connected at 286 with carriage 272 is an elongated rod 284 which extends through a bearing 283 swivelly-mounted on a cross arm 288 interconnecting the two arms 266. In the FIG. 10 finish position bearing 283 engages a coil spring 290 which encircles rod 284; in the dotted line start position bearing 283 engages a coil spring 282. Spring abutments are provided on the rod at 292 and 294.

Carriage members 268 carry pivotal links 276 and 278 which are tied together by rods 280. The lower end portions of these links are equipped with pressure members 279 which register with heads 94 on the subjacent traveling cores during leftward movement of the carriage. Tension springs 300 normally hold the links in their illustrated vertical positions against carriage-mounted stops 300.

As carriage 272 moves rightwardly from its FIG. 10 position rod 284 slides in bearing 283, and arms 266 are held in buckled conditions with respect to links 262 by tension springs 265. As carriage 268 nears its dotted

line start position spring 282 strikes bearing 283 and causes arms 266 and links 262 to straighten or unbuckle. Pivot 264 goes overcenter with respect to the line of action of spring 265 so that the spring holds arms 266 and links 262 in their straightened conditions. In their straightened conditions the links and arms cause members 268 to assume lowered positions preparatory to engagement between pressure members 279 and latch heads 94.

During leftward movement of carriage 268 members 279 are moving in synchronism with the mold cavity member carriers 36; there is therefore no relative horizontal motion between members 279 and latch heads 94. The straightened links 262 and arms 266 cause members 268 to gradually descend during the first portion of the movement and to gradually ascend during the last portion of the movement. While members 266 are moving toward the six o'clock position latch rods 88 are being depressed; while arms 266 are moving from the six o'clock position to the seven o'clock position springs 96 urge the latch rods upwardly to positions in which heads 90 are disengaged from the detents 86.

Pressure members 279 are designed to engage heads 94 at points slightly rightwardly of the latch rod axes so that the rods are tilted as they are moved downwardly; therefore the conical latch heads 90 are snapped leftwardly out of alignment with detents 86 as they move upwardly under the influence of springs 96. In the event that pressure members 279 do not engage offset points on heads 94 cam followers 296 on arms 266 automatically strike cam surfaces 298 on links 276 at about the six o'clock position of arms 266 (while they are still straightened). Links 276 and 278 are thus shifted slightly rightwardly to change their points of engagement with heads 94. The desired tilting of latch rods then takes place before heads 90 have reached plates 98.

During the major portion of the leftward movement of carriage 268 arms 266 and link 262 are in their straightened condition. However, as the leftmost position is neared spring 290 engages bearing 283; at this time the upward motion of carriage 268 is hampered by the restraining action of links 274. Pivot points 285 between the carriage and arms 266 thus tend to be held down, and the arms thus buckle on links 262.

While links 262 and arms 266 are moving in their straightened conditions (the major portion of the leftward stroke) pressure members 279 describe relative low arcs whereby to operate on the latch heads 94. While links 262 and arms 266 are moving in their buckled conditions (the major portion of the rightward stroke) pressure members 279 describe relatively high arcs whereby to clear the oncoming latch heads of the next succeeding casting cores 68. Springs 265 maintain arms 266 and links 262 in their straight and buckled conditions respectively during the respective movements. Spring 282 acts as a straightener device during the latter stages of the rightward movement and spring 290 acts as a buckler device during the latter stages of the leftward movement.

#### *Core removal machine (FIG. 10)*

The illustrated machine comprises an upstanding carriage 272 having grooved wheels 110 running on tracks 112. Pivotally mounted at 302 on the carriage are arms 304 which are adapted to register with pins 168 on the advancing carrier 36. Thus the carrier drives the carriage from dotted line start position 172a to the full line finish position, after which rod 226 on bell crank 222 strikes the fixed abutment 306 to unbuckle the bell crank and link 224, whereby to disengage arm 304 from pin 168. The action is similar to that which occurs during operation of the FIG. 6 core setting machine.

Carriage 272 carries weighted elevators 308, which are suitably guided by the diagrammatically illustrated rollers 310. Support for the elevators is provided by connecting them to endless chains 314 which are trained around upper carriage-mounted sprockets 316 and lower carriage-

mounted sprockets 318; the elevator-chain connections are diagrammatically illustrated by anchorages 312.

The shafts for sprockets 316 also carry sprockets 320 which cooperate with carriage-mounted idler sprockets 322 to mount endless chains 324. Anchorages 326 connect chains 324 with chains 328 which extend downwardly around carriage-mounted sprockets 330 and over to fixed anchorages 332.

It will be seen that as arms 304 are retracted from pins 168 the weights of elevators 308 act on anchorages 312 to cause chains 314 to rotate sprockets 316 and 320 counterclockwise. The elevators descend, and chains 324 move in the arrow 334 direction to elevate anchorages 326; carriage 272 is necessarily moved rightwardly to the dotted line position 172a. The simultaneous horizontal movement of carriage 272 and vertical movement of elevators 308 are derived from the release of energy which has been accumulated in elevators 308 during leftward movement of the carriage.

When carriage 272 is in its rightward start position elevators 308 are in lowered conditions approximately level with sprockets 318. As pins 168 drive the carriage leftwardly anchorages 326 move downwardly toward sprockets 322, and chains 334 thus rotate sprockets 320 and 316 clockwise. Chains 314 are thus operated to raise elevators 308 upwardly to the illustrated finish position.

Disposed on elevators 308 are inwardly extending ledges 336 arranged during leftward movement of the carriage to engage portions 41 of the casting cores to thus lift the cores from the mold cavity members 62. The removed casting cores are thus caused to be located with portions 78 thereof disposed slightly above the hooks 55 on the overhead conveyor 22. During the upward movement of elevators 308 there is no relative horizontal movement between hooks 55 and the elevator-supported casting cores. Before hooks 55 can engage portions 78 to support the casting cores carriage 272 must have a rightward movement relative to hooks 55. In the illustrated arrangement this relative rightward movement is provided by holding the carriage motionless for a brief period after elevator 308 reaches its elevated position; this allows the continuously advancing hooks 55 to move underneath portions 78.

The mechanism for holding carriage 272 motionless comprises a cam follower 338 arranged to be tripped by the oncoming roller 52 of the overhead conveyor. When tripped the cam follower shifts rod 340 rightwardly, which in turn operates shaft 342 and arm 344 counterclockwise. Cooperating with arm 344 is a vertical rod 346 suitably mounted in carriage 272 for up and down movement. As carriage 272 reaches the limit of its leftward movement the laterally extending pin portion 348 on the upper end of rod 346 moves above arm 344. Roller 52 subsequently trips cam follower 338, causing rod 340 and the associated elements to raise rod 346. Rod 346 is an operator for a suitable switch or valve (not shown) which controls a cushioning cylinder 350. The cylinder is effective to hold the carriage in its leftmost position until rod 346 is raised to operate its switch or valve. In this way we are insured of having hooks 55 reach their designated positions below core portions 78 preparatory to descending movement of elevators 308. If desired rod 346 can also be used to trip a mechanical latch (not shown) which holds elevators 308 in their raised positions; the arrangement insures proper timing in spite of leakage in cylinder 350.

#### Article transfer machine (FIGS. 11 through 13)

As shown in FIG. 1, the mold cavity members, with the cast articles therein, pass through the article hardening drier 102 and the article transfer machine 11, at which time the machine automatically lifts the cast articles from the mold cavity members and transfers them to a finishing conveyor 104. The lifting and transferring operation

is performed by an arm 352 which enjoys vertical and rotary motion.

As shown in FIG. 11 the machine comprises a fixed base or table structure 354 having two V-tracks 356 on its upper surface for accommodating rollers 358 of a carriage 360. The carriage is thus mounted for longitudinal movement parallel with the conveyors 36 and 104 (FIG. 1). As shown in FIG. 11, the carriage is in an intermediate position between its leftmost position 360a and its rightmost position 360b. To shift the carriage along tracks 356 there are provided two vertical shafts 362, only one of which is visible in FIG. 11. Each shaft is provided with a sprocket 364 at its lower end and a sprocket 366 at its upper end. Cooperating with sprockets 366 are additional idler sprockets 368 and endless chains 370 trained therearound. The two lower sprockets 364 are arranged to be continually chain driven from the drive unit for the aforementioned upper and lower conveyors 22 and 36; the arrows in FIG. 12 indicate the directions taken by these sprockets.

Suitably affixed to a link of each chain 370 is an upstanding pin or roller 372 located within a transverse slot 374 in a plate 376 which forms part of carriage 360. It will be seen that rollers 372 drive carriage 360 rightwardly as they move along the inside runs of chains 370 and leftwardly as they move along the outside runs of the chains. While the rollers are moving around sprockets 366 and 368 the carriage decelerates and then accelerates in the opposite direction to a speed exactly equal to the speed of the conveyor then underlying arm 352.

The carriage movement is correlated with movement of transfer arm 352, whereby the carriage moves leftwardly when the arm overlies carriers 36 and rightwardly when the arm overlies conveyor 104. The carriage thus keeps pace with carriers 36 while the transfer arm is lifting the cast articles from the mold cavity members, and the carriage also keeps pace with the article-finishing conveyor 104 while the transfer arm is depositing the cast articles on the ware finishing conveyor. While the transfer arm is rotating between its full line and dotted line positions (FIG. 1) carriage 360 is retarded and then accelerated in the opposite direction, i.e., rollers 372 are then moving around the peripheries of sprocket 366 or 368.

As shown in FIG. 13, the outer end portion of transfer arm 352 carries a bar 380 which acts as a suspension means for links 382 and depending arms 384. The arms carry vacuum fittings 386 for suction cups 388. In the FIG. 13 position suction cups 388 are engaged with the inner surfaces of a cast article 390, whereby vacuum applied to fittings 386 causes the cast article to be gripped by the suction cups. Preferably each fitting 386 is provided with a small atmospheric orifice communicating with the respective vacuum cup. A leak occurring in one or two of the vacuum cups will then have a relatively minor effect on the supply vacuum, and the cast article can be gripped and lifted as though no leaks had occurred.

Pivotaly suspended from an intermediate portion of bar 380 is a housing 392 having an internal diaphragm 394 connected with a pin 396 which extends through a cross head 398. Links 400 interconnect the cross head with arms 384. In the FIG. 13 position compression springs 402 are effective to urge cross head 398 downwardly, thereby forcing arms 384 outwardly, whereby the suction cups 388 are intimately engaged with the inner surfaces of cast article 390.

A suitable valve (not shown) selectively directs vacuum either to fittings 386 or vacuum chamber 404. When vacuum is withdrawn from fittings 386 and applied to chamber 404 diaphragm 394 is drawn upwardly to withdraw the suction cups 388 from gripping engagement with the cast article surfaces. When vacuum is withdrawn from chamber 404 and applied to fittings 386 springs 402 cooperate with the applied vacuum to cause cups 388 to grip the cast article.

As shown in FIG. 11, transfer arm 352 is secured to the upper portion of a shaft 406 which is mounted for axial and rotary motion in a bearing 408 on the carriage 360. The lower end of shaft 406 extends through hidden bearings in trunnion mechanism 410 to connect with a sprocket 412 which is horizontally aligned with a second idler sprocket 414 mounted on a suitable support structure 416. Structure 416 is rigid with trunnions 410, and the trunnions are in turn suspended from links 418, which are in turn suspended from arms 420. Arms 420 are pivotally mounted at 422 on a carriage-supported bracket structure 424. Thus the carriage supports arms 420, the links 418, trunnions 410 and support structure 416.

Depending from carriage 360 is a bracket structure 426 which mounts a vertically disposed hydraulic cushioned air cylinder 428. The piston portion of cylinder 428 is connected with a cross head 430 (FIG. 13) which carries depending links 432, said links having their lower ends pivotally connected with arms 420, whereby the introduction of pressure fluid into the lower end of cylinder 428 causes arms 420 to be raised about pivots 422, thereby raising the assembly of trunnions 410, support structure 416 and shaft 406. Transfer arm 352 thus moves upwardly to the dotted line position 352a. Preferably carriage 360 is equipped with a depending post or guide 434, and support structure 416 is equipped with cooperating rollers (not shown) to guide the movable structures during the elevating and lowering movements.

Trained around sprockets 412 and 414 is an endless chain 436 having an anchorage at 438 with the piston of a hydraulic cushioned air cylinder 440 which is mounted on support structure 416. At a suitable point in the operating cycle cylinder 440 is energized to operate its piston, thereby moving endless chain 436 and rotating the sprocket 412. The shaft 406, which is connected with sprocket 412 thereby is rotated to rotate the transfer arm 352. The stroke of the piston for cylinder 440 is chosen to provide 180° movement of the transfer arm.

The desired operating cycle of the transfer machine is substantially as follows:

With arm 352 in an elevated condition overlying one of the carriers 36 rollers 372 (FIG. 12) will be moving on the outer runs of chains 370, whereby carriage 360 is moving with mold cavity members 62. While the carriage is moving toward position 360a cylinder 428 is energized to lower shaft 406, after which vacuum is transferred from chamber 404 (FIG. 13) to the vacuum cup fittings 386, thereby causing the vacuum cups to grip the cast article 390. While carriage 360 is still moving leftwardly, cylinder 428 is energized to elevate shaft 406, thereby lifting the cast article from the mold cavity members on carriers 36.

As rollers 372 start their turns around sprockets 368, cylinder 440 is energized to rotate shaft 406, thereby turning the elevated transfer arm 352 from its FIG. 1 full line position to its dotted line position disposed above conveyor 104.

As rollers 372 are moving down the inner runs of chains 370 cylinder 428 is energized to lower shaft 406; at this time carriage 360 is moving leftwardly in step with conveyor 104, and transfer arm 352 is thereby enabled to gently deposit the cast article onto the conveyor without any relative horizontal motion between the conveyor and cast article.

While rollers 372 are still proceeding along the inner runs of chains 370 vacuum is shifted from the vacuum cup fittings 386 to the vacuum chamber 304, thereby withdrawing the vacuum cups 388 from the surfaces of the cast article. Cylinder 428 is then energized to elevate shaft 406 and the FIG. 13 gripper mechanism out of the cast article.

The cycle is completed as rollers 372 turn around sprockets 366; at this time carriage 360 is decelerating, reversing itself and accelerating in the opposite direction. Cylinder 440 is energized to rotate shaft 406 for return-

ing the transfer arm 352 to its FIG. 1 full line position.

The machine is preferably controlled by suitable fixed cam surfaces cooperating with lever operators for the supply valves for cylinders 428 and 440 and the vacuum supply valve (not shown).

#### Features of the invention

One primary feature of the invention is the concept wherein the upper and lower conveyors 22 and 35 are moving continuously without indexing or stop and go motions. This feature minimizes wear and thus contributes to long service life.

Because each of the conveyors is moving continuously the various machines must be mounted for longitudinal movement to keep pace with the conveyors. Advantageously the synchronization of the machines with the conveyors is achieved mechanically by utilizing the motion of the conveyors to drive the machines. This eliminates many electric controls and fluid cylinders which would otherwise be required to provide proper synchronization. A major advantage in the arrangement is the lack of down time which is involved in the rather costly maintenance of such electric controls and fluid cylinders. A further advantage stemming from the mechanical synchronization concept is that it is operative irrespective of dimensional variations due for example to differential thermal expansions, manufacturing, tolerances, or uneven wear.

What is claimed:

1. A molding machine comprising a first continually moving overhead conveyor for casting cores; a second continually moving lower conveyor for mold cavity members; first means for applying mold release material to the cores as they are moved along by their conveyor; second means located downstream from the first means for removing the cores from the overhead conveyor and depositing same in the moving mold cavity members on the lower conveyor; third means downstream from the second means for clamping the moving cores in the moving mold cavity members; fourth means downstream from the third means for feeding liquid casting material into the defined moving mold cavities; fifth means downstream from the fourth means for automatically unclamping the moving cores from the moving mold cavity members; sixth means downstream from the fifth means for automatically transferring the moving cores from the moving mold cavity members onto the overhead conveyor; and seventh means downstream from the sixth means for automatically lifting and removing the formed articles from the moving mold cavity members.

2. A casing machine comprising a first continually moving overhead conveyor for casting cores; a second continually moving lower conveyor for mold cavity members; first means automatically operable to remove individual casting cores from the overhead conveyor and deposit same in the moving mold cavity members without halting either conveyor; second means downstream from the first means for feeding liquid casting material into the defined mold cavities without halting the lower conveyor; and third means downstream from the second means for automatically transferring cores from filled mold cavity members onto the overhead conveyor without halting either conveyor.

3. A casting machine comprising a first continually moving overhead conveyor for casting cores; a second continually moving lower conveyor for mold cavity members; first means for applying mold release material to the cores as they are moved along by their conveyor; second means located downstream from the first means and operable automatically to remove individual cores from the overhead conveyor and deposit same in the moving mold cavity members on the lower conveyor; third means downstream from the second means for automatically clamping the cores in the mold cavity members; fourth means downstream from the third means for feeding liquid casting material into the defined mold cavities; fifth

means downstream from the fourth means for automatically unclamping the cores from the mold cavity members; and sixth means downstream from the fifth means for automatically transferring the cores from the mold cavity members onto the overhead conveyor; each of said means being mechanically powered and controlled by the conveyors.

4. A casting machine comprising a continually moving endless overhead conveyor for plaster cores; a second continually moving endless lower conveyor for plaster mold cavity members running at substantially the same speed as the overhead conveyor; first means including a first carriage for applying mold release powder to the cores as they are moved along by their conveyor; second means including a second carriage downstream from the first carriage for automatically removing plaster cores from the overhead conveyor and depositing same in moving mold cavity members on the lower conveyor; third means including a third carriage downstream from the second carriage for automatically clamping cores in their mated mold cavity members; fourth means including a fourth carriage downstream from the third carriage for feeding liquid casting material into the defined mold cavities; fifth means including a fifth carriage downstream from the fourth carriage for automatically unclamping the cores from the mold cavity members; sixth means including a sixth carriage downstream from the fifth carriage for automatically transferring cores from the mold cavity members onto the overhead conveyor; seventh means including a seventh carriage downstream from the sixth carriage for automatically removing cast articles from the mold cavity members on the lower conveyor; means mounting each of said carriages for reciprocating movement longitudinally of the lower conveyor; and releasable driving connections between the lower conveyor and carriages for causing the lower conveyor and each carriage to move in synchronism during the time periods while each respective means is performing its function on the cores and/or mold cavity members.

5. In a machine for casting articles: the combination comprising a continuously moving overhead conveyor; a line of casting cores supported on said conveyor for movement therewith; a second continuously moving conveyor running below the overhead conveyor; a line of mold cavity members supported on said second conveyor for movement therewith; and means for automatically lowering individual cores from the overhead conveyor into individual mold cavity members without stopping either conveyor; said lowering means comprising a carriage movable with the lower conveyor between a start position and a finish position, an elevator mounted on said carriage for movement to a raised position as the carriage moves toward the start position and to a lowered position as the carriage moves toward the finish position, and a rotary transfer mechanism operable to transfer individual cores from the overhead conveyor to the elevator while it is in its raised position.

6. In a machine for casting articles: the combination comprising a continuously moving overhead conveyor; a line of casting cores supported on said conveyor for movement therewith; a second continuously moving conveyor running below the overhead conveyor; a line of mold cavity members supported on said second conveyor for movement therewith; and means for automatically lowering individual cores from the overhead conveyor into individual mold cavity members without stopping either conveyor; said lowering means comprising a carriage movable with the lower conveyor between a start position and a finish position, an elevator mounted on said carriage for movement to a raised position as the carriage moves toward its start position and to a lowered position as the carriage moves toward its finish position, and rotary transfer mechanism operated by the overhead conveyor for transferring individual cores from the overhead conveyor to the elevator while it is in its raised position; said transfer mechanism comprising a transfer arm

having a continuous 360° rotary motion about a fixed horizontal axis, whereby to lift individual cores from the overhead conveyor with an ascending motion and deposit same on the elevator with a descending motion.

7. In a machine for casting articles: the combination comprising an overhead conveyor; a line of casting cores supported on said conveyor for movement therewith; a lower conveyor movable beneath the overhead conveyor; a line of mold cavity members supported on said lower conveyor; first means for applying mold release powder to individual ones of the cores while they are being moved by the overhead conveyor; second means downstream from the first means for transferring individual cores from the overhead conveyor into individual mold cavity members on the lower conveyor; third means downstream from the second means for automatically clamping the transferred cores on their mold cavity members; and fourth means downstream from the third means for admitting predetermined quantities of casting liquid into individual ones of the defined mold cavities.

8. In a machine for casting articles: the combination comprising an overhead conveyor; a line of casting cores supported on said conveyor for movement therewith; a lower conveyor movable beneath the overhead conveyor; a line of mold cavity members supported on said lower conveyor; first means for applying mold release powder to individual ones of the cores while they are being moved by the overhead conveyor; second means downstream from the first means for transferring individual cores into individual mold cavity members on the lower conveyor; third means downstream from the second means for automatically clamping the transferred cores on their mold cavity member; fourth means downstream from the third means for admitting predetermined quantities of casting liquid to individual ones of the defined mold cavities; and means releasably coupled to the lower conveyor for causing said first, second, third and fourth means to periodically move bodily with said lower conveyor, whereby the powder applying, core transferring, core clamping, and liquid admitting operations are performed without interrupting the conveyor movements.

9. In a machine for casting articles: the combination comprising an overhead conveyor; a line of casting cores supported on said conveyor for movement therewith; a lower conveyor movable beneath the overhead conveyor; a line of mold cavity members supported on said lower conveyor; first means for applying mold release powder to individual ones of the cores while they are being moved by the overhead conveyor; second means downstream from the first means for transferring individual cores into individual mold cavity members on the lower conveyor; third means downstream from the second means for admitting predetermined quantities of casting liquid to individual ones of the defined mold cavities; driver elements located on said lower conveyor at spaced intervals corresponding to the spacing between the mold cavity members; a retractable driven element carried on at least one of said first, second, and third means for engagement with successive driver connections on the lower conveyor to move said means from predetermined start positions; a storable energy power device associated with at least one of said first, second and third means; and mechanism operable to retract the driven element from engagement with the associated driver connection after predetermined movement thereof, whereby release of the aforementioned driving connection permits the stored energy power device to return the first, second, third and fourth means to their start positions.

10. In a machine for casting articles: the combination comprising a continuously moving overhead conveyor; a continuously moving lower conveyor; a line of mold cavity members supported on said lower conveyor, and casting cores removably arranged in individual ones of the mold cavity members: the improvement comprising means for automatically transferring individual cores from the mold cavity members to the upper conveyor without interrupt-

ing the movement of either conveyor; said transfer means comprising a carriage movable from a start position to a finish position, an elevator mounted for up and down movement on said carriage, and means correlating the elevator movement with the carriage movement, whereby the elevator is caused to position the casting cores in horizontal registry with the overhead conveyor when said elevator is in its up position and said carriage is in its finish position.

11. In a machine for casting articles: the combination comprising a continuously moving overhead conveyor; a continuously moving lower conveyor; a line of mold cavity members supported on said lower conveyor, and casting cores removably arranged in individual ones of the mold cavity members: the improvement comprising means for automatically transferring individual cores from the mold cavity members to the upper conveyor without interrupting the movement of either conveyor; said transfer means comprising an elevatable carrier reciprocably movable between a lower start position and an upper finish position and means timed from the overhead conveyor for preventing the carrier from moving from the finish position to the start position until the individual cores are disposed within the upper conveyor.

12. In a machine for casting articles comprising a continuously moving overhead conveyor; a continuously moving lower conveyor; a line of mold cavity members supported on said lower conveyor; casting cores removably arranged in individual ones of the mold cavity members; and means comprising two disengageable members for clamping individual cores in individual mold cavity members: the improvement comprising a first means automatically operable to disengage the two clamping members without halting the mold cavity member movement; and second means automatically operable to transfer individual casting cores from the mold cavity members into supported positions on the overhead conveyor without halting the mold cavity member movement.

13. In a machine for casting articles comprising a continuously moving overhead conveyor; a continuously moving lower conveyor; a line of mold cavity members supported on said lower conveyor; casting cores removably arranged in individual ones of the mold cavity members; and means comprising two disengageable members for clamping the individual cores in the individual mold cavity members: the improvement comprising a first means automatically operable to disengage the two clamping mem-

bers without halting the mold cavity member movement; second means automatically operable to transfer individual casting cores from the mold cavity members into supported positions on the overhead conveyor without halting the mold cavity member movement; and third means mechanically interconnecting the first means and the second means for causing them to move in synchronism with one another.

14. In a machine for casting articles comprising a continuously moving overhead conveyor; a continuously moving lower conveyor; a line of mold cavity members supported on said lower conveyor; casting cores removably arranged individual ones of the mold cavity members; and means comprising two disengageable members for clamping the individual cores in individual mold cavity members: the improvement comprising first reciprocable means automatically operable to disengage the two clamping members without halting the mold cavity member movement; second reciprocable means automatically operable to transfer individual casting cores from the mold cavity members into supported positions on the overhead conveyor without halting the mold cavity member movement; drive means releasably connected between the lower conveyor and said first and second means, whereby said lower conveyor moves said means during certain portions of their reciprocable movements; and storable energy power mechanism energized during said certain portions whereby to move said means during other portions of their reciprocable movements.

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