Sept. 11, 1956 P. KLAMP ET AL 2,762,092

TURNTABLE TYPE MACHINES FOR FORMING SHELL MOLDS

Filed July 18, 1952

13 Sheets-Sheet 1

FIG. 1

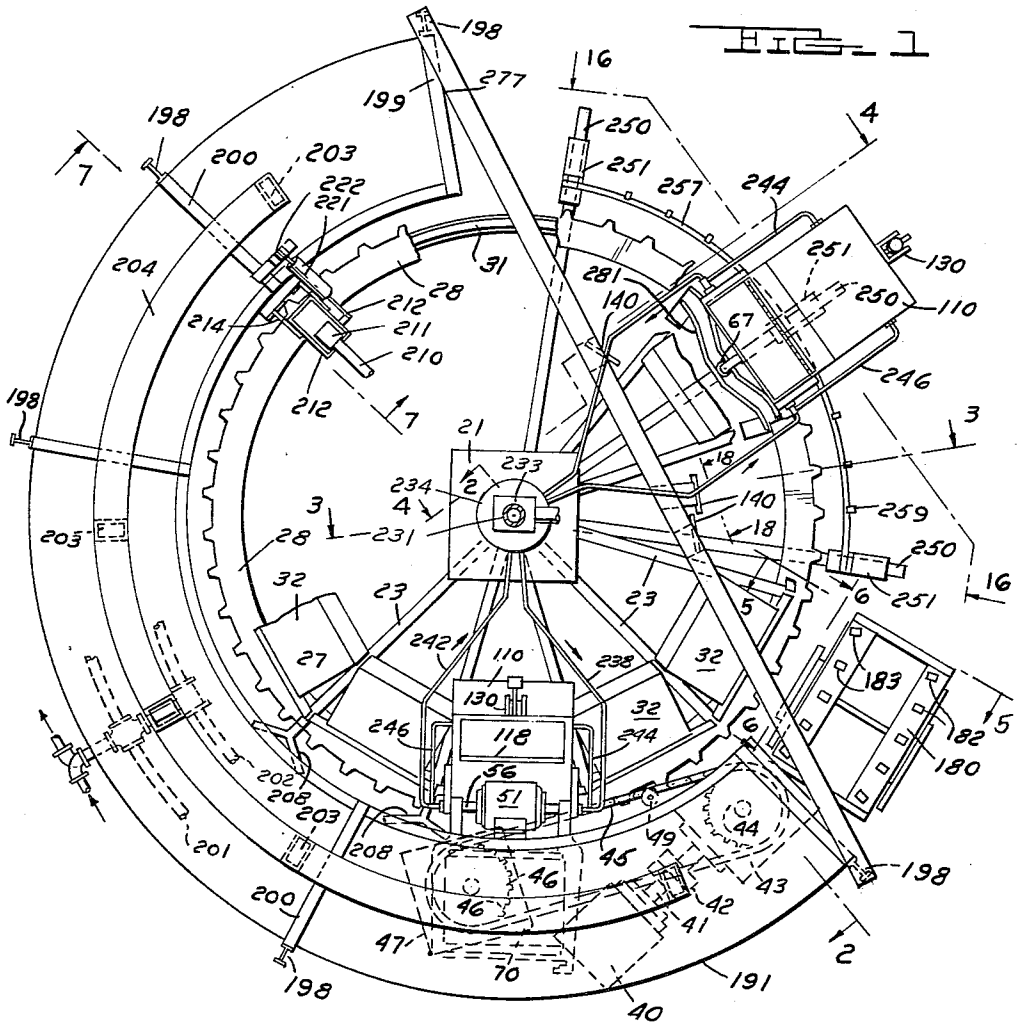
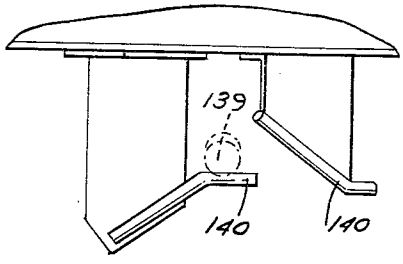



FIG. 1B




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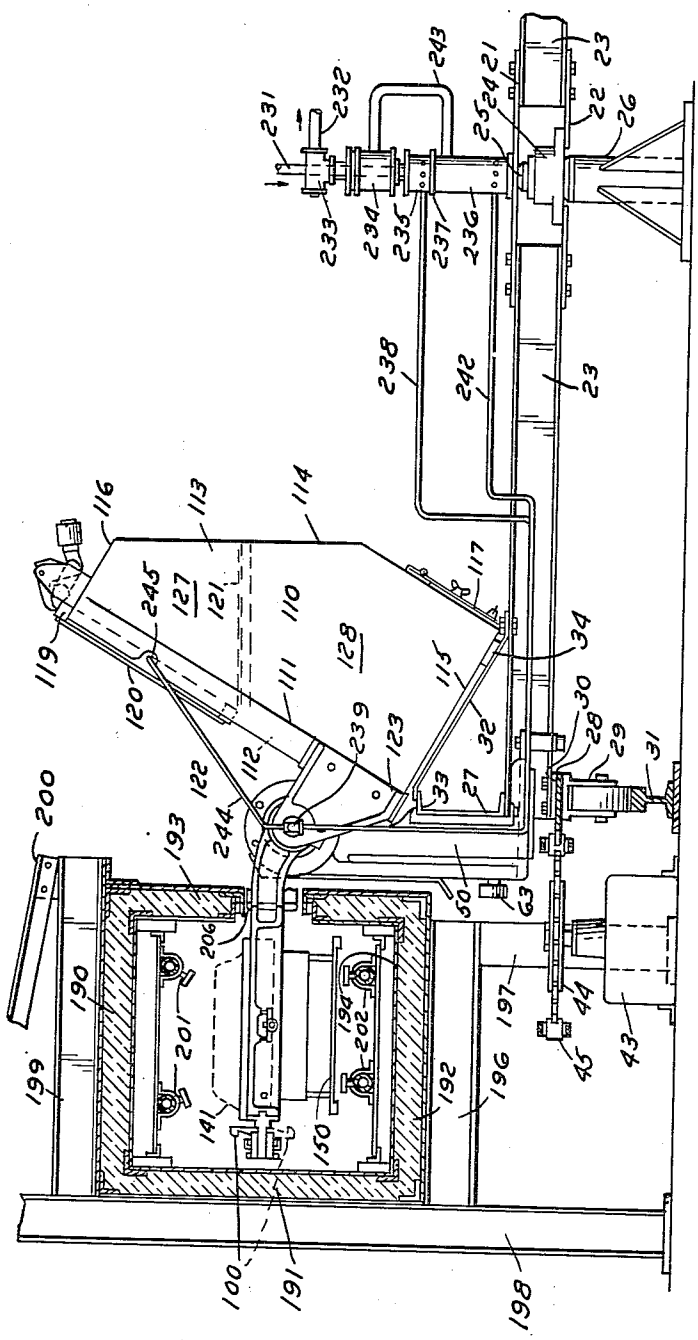



FIG. 2

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13 Sheets-Sheet 3

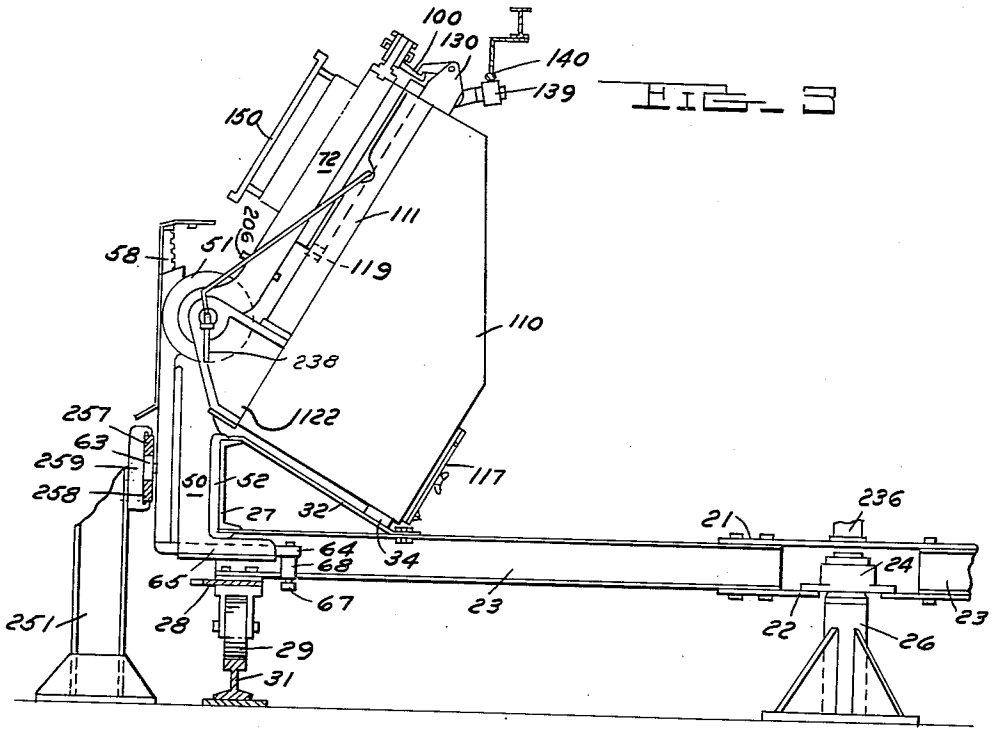



FIG. 3

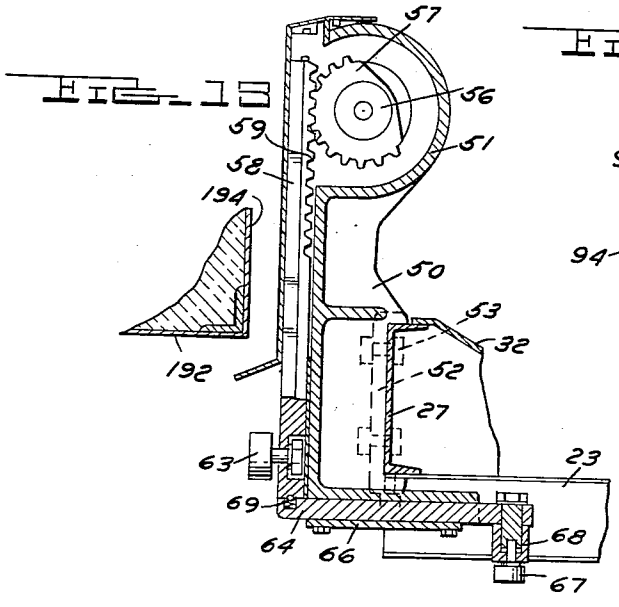



FIG. 1B

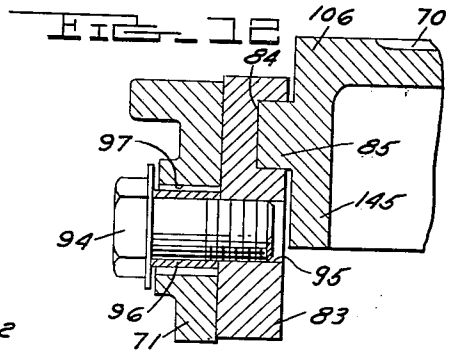


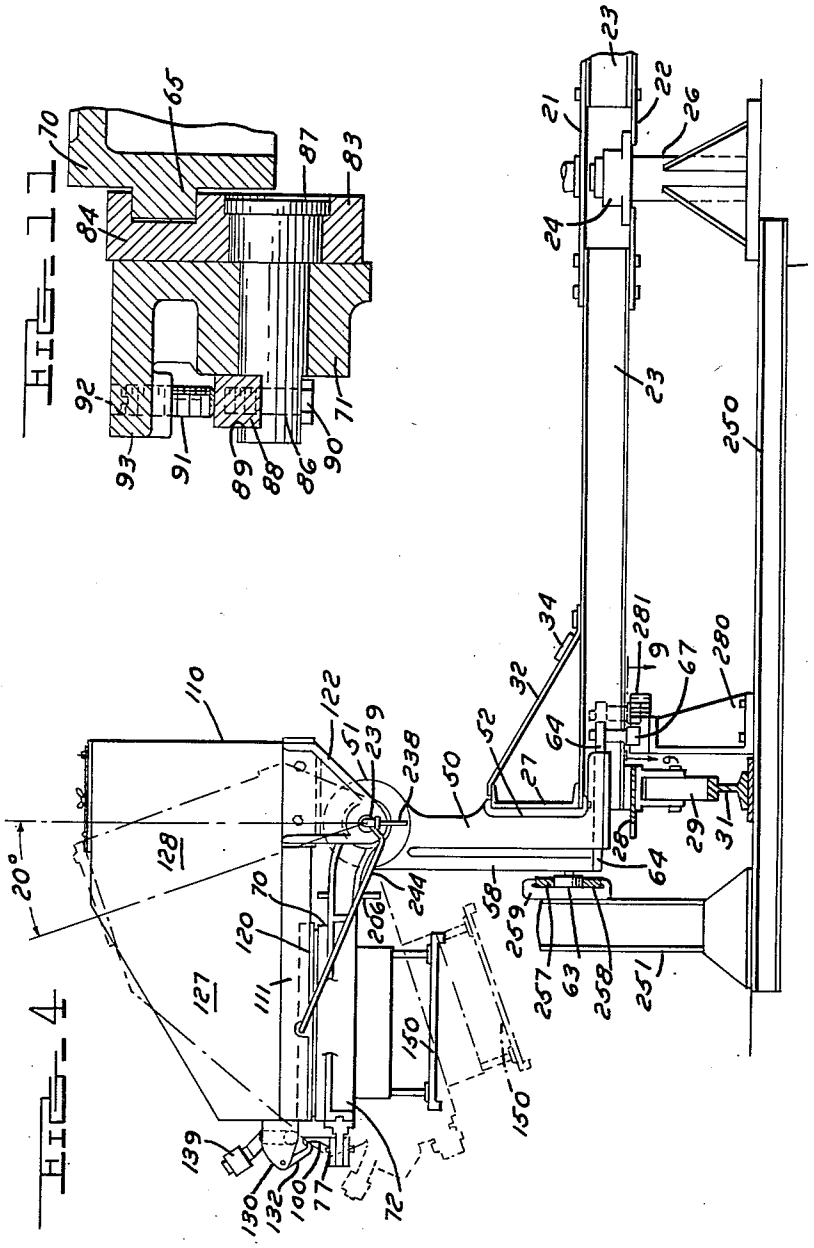

FIG. 1C

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TURNTABLE TYPE MACHINES FOR FORMING SHELL MOLDS

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TURNTABLE TYPE MACHINES FOR FORMING SHELL MOLDS

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FIG. 5

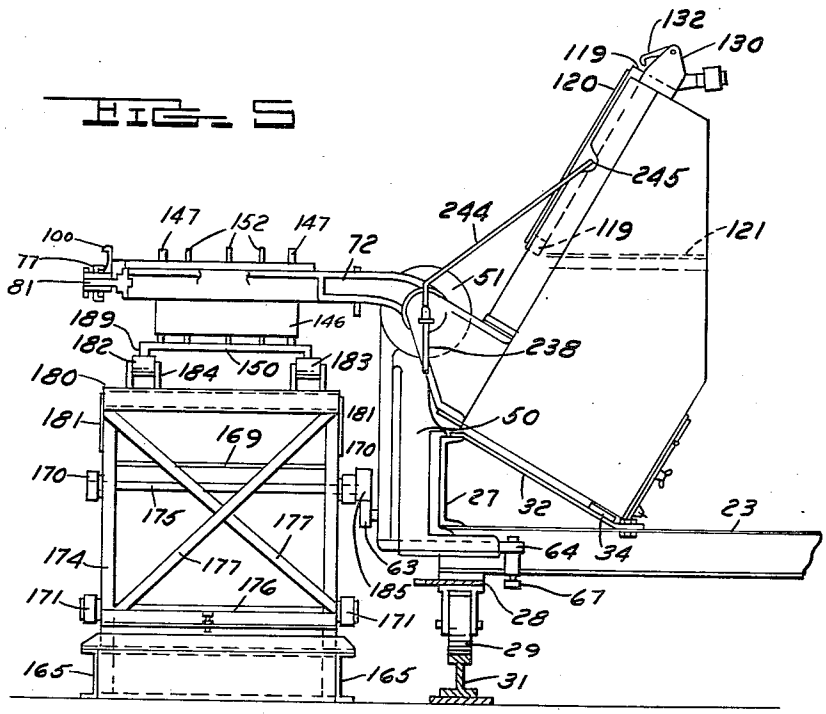



FIG. 16

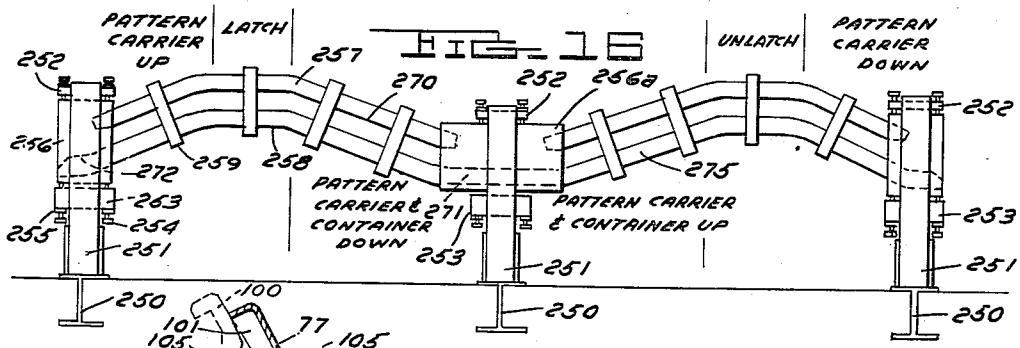
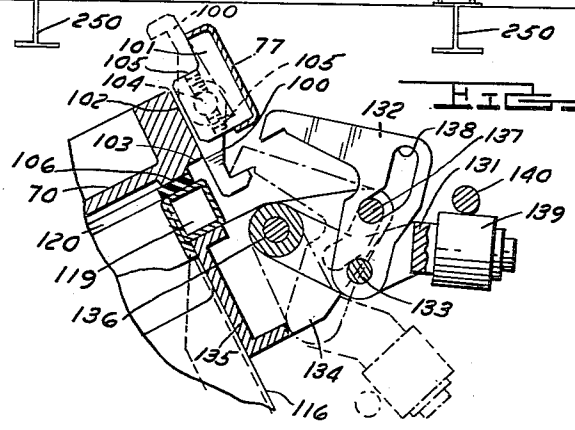



FIG. 17




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TURNTABLE TYPE MACHINES FOR FORMING SHELL MOLDS

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FIG. 6

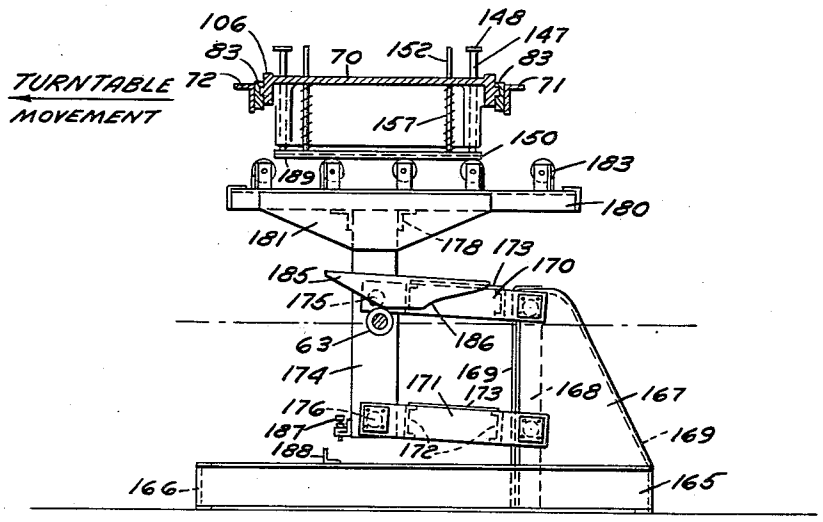



FIG. 15

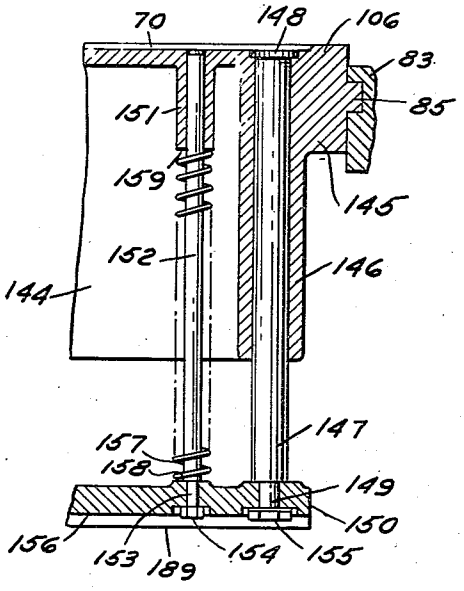
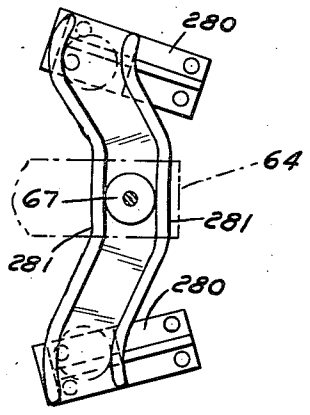



FIG. 9




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TURNTABLE TYPE MACHINES FOR FORMING SHELL MOLDS

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FIG. 7

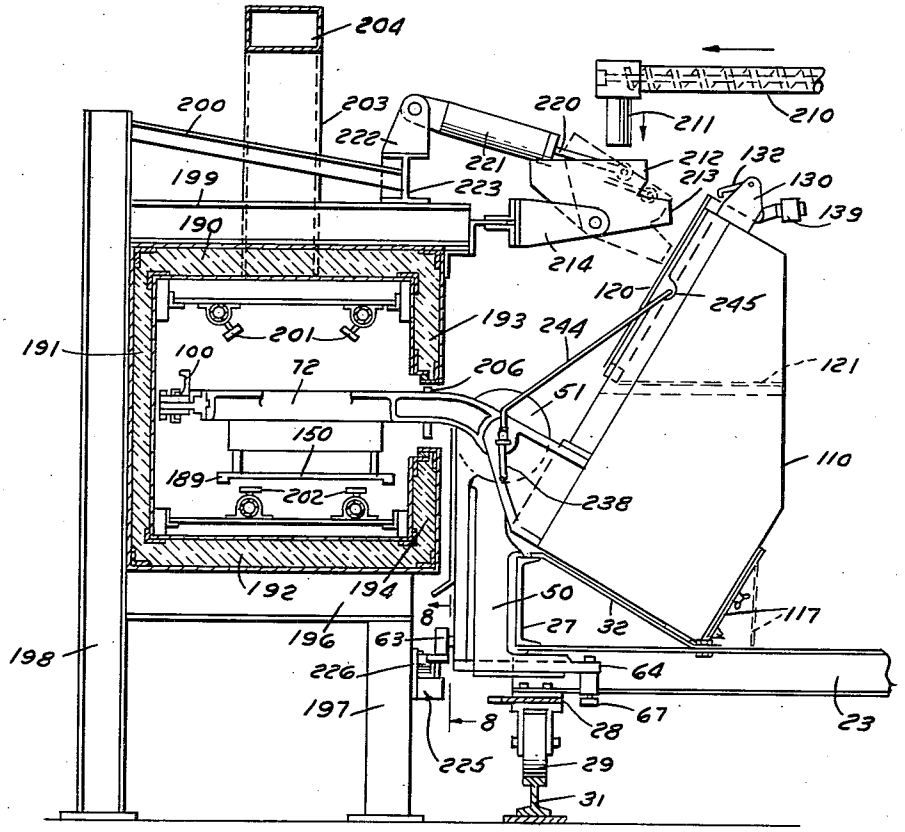
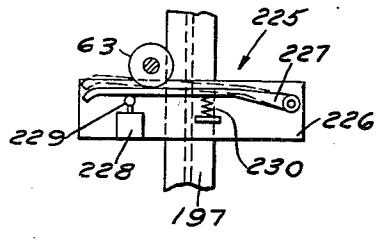



FIG. 8




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TURNTABLE TYPE MACHINES FOR FORMING SHELL MOLDS

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FIG. 10

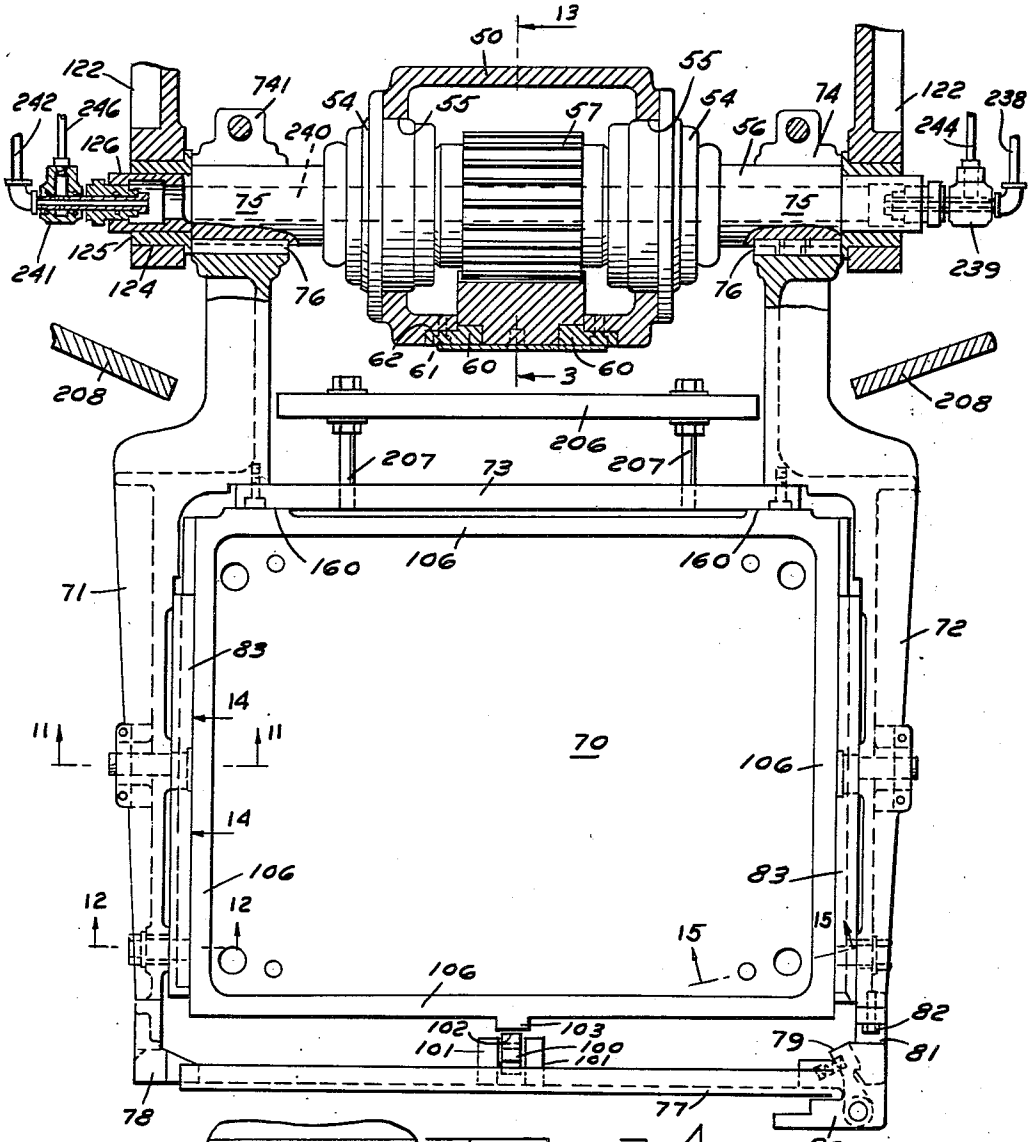
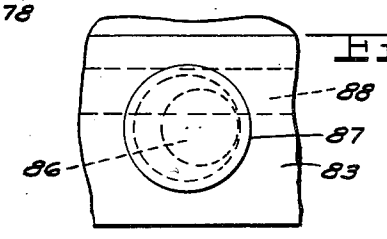



FIG. 14




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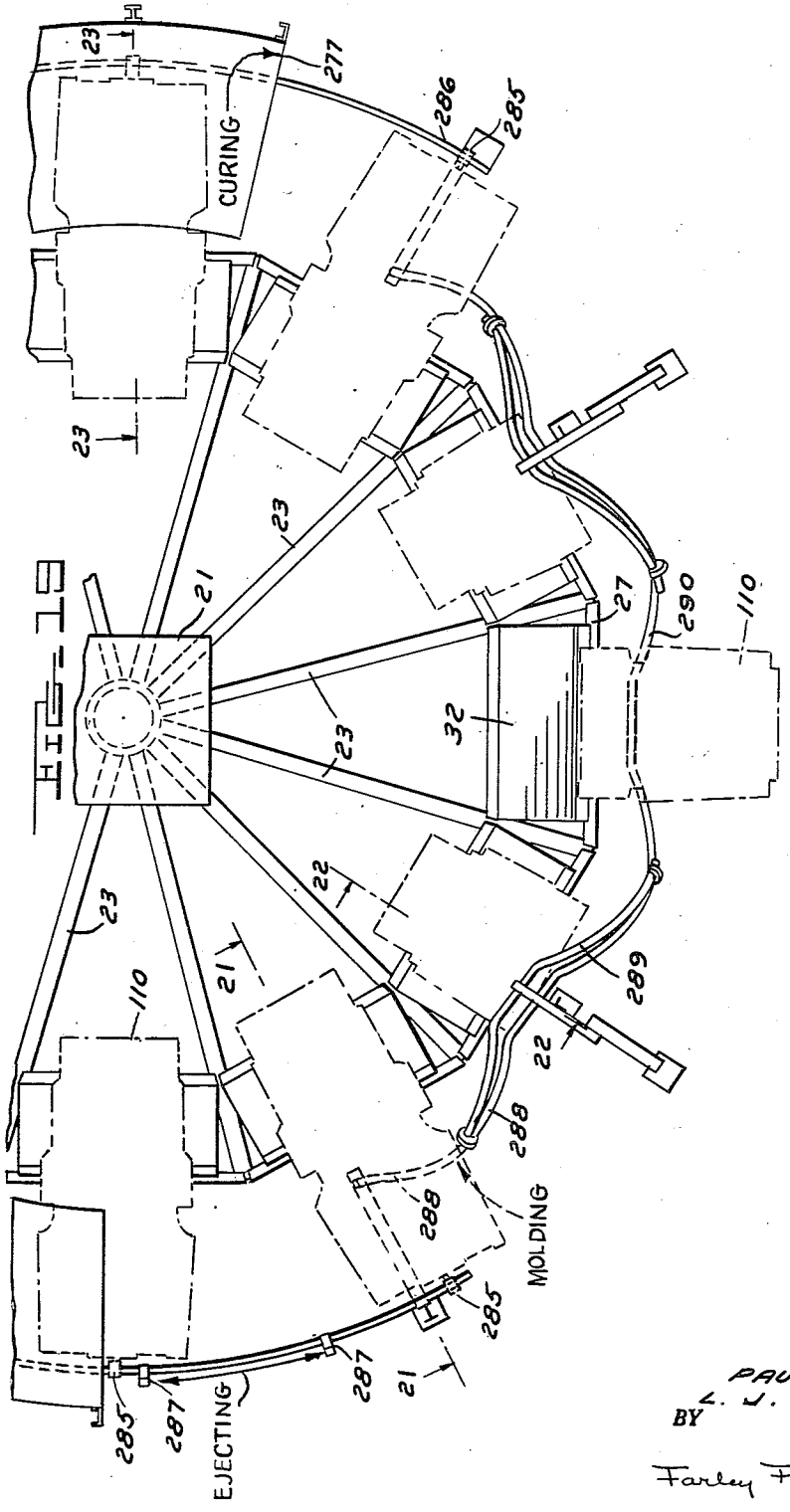



FIG. 8

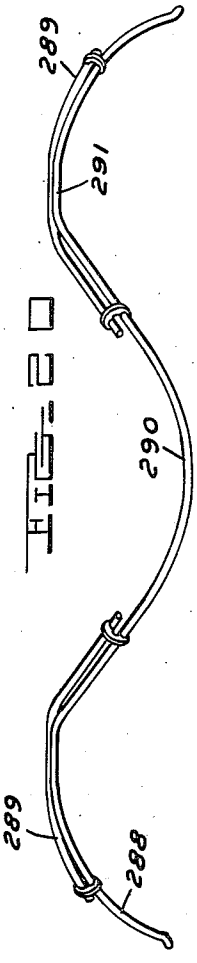



FIG. 20

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FIG. 23

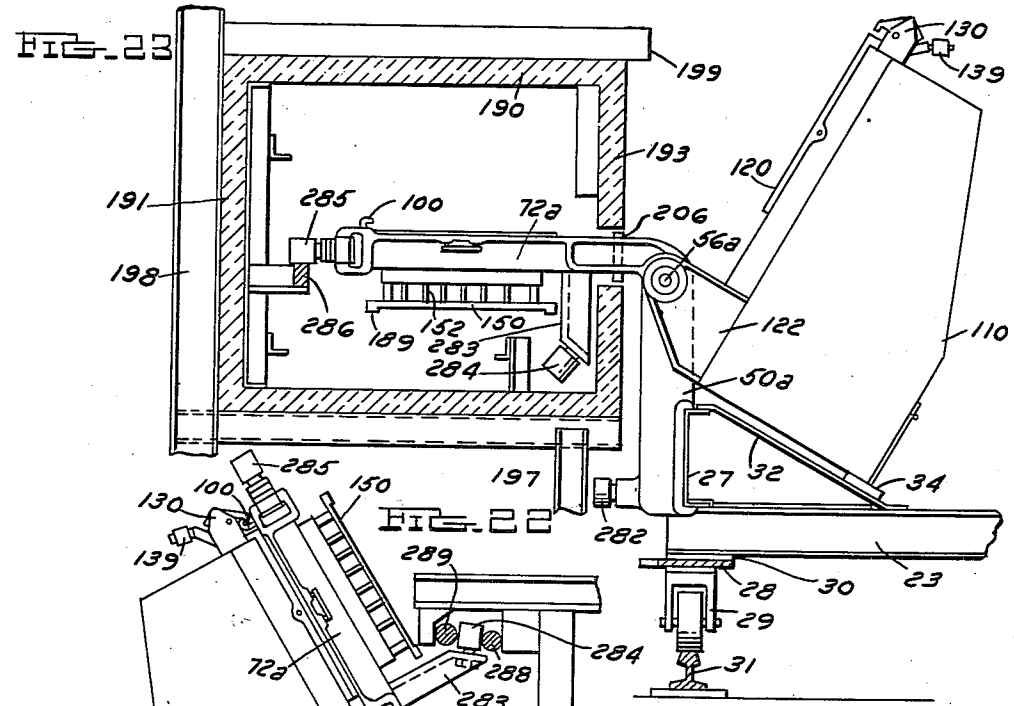
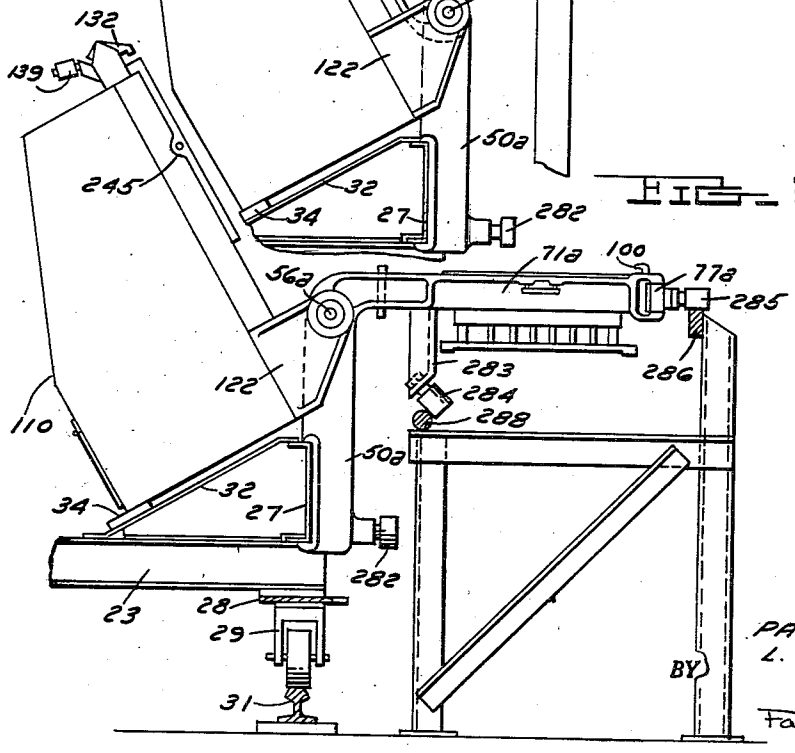



FIG. 22




FIG. 21




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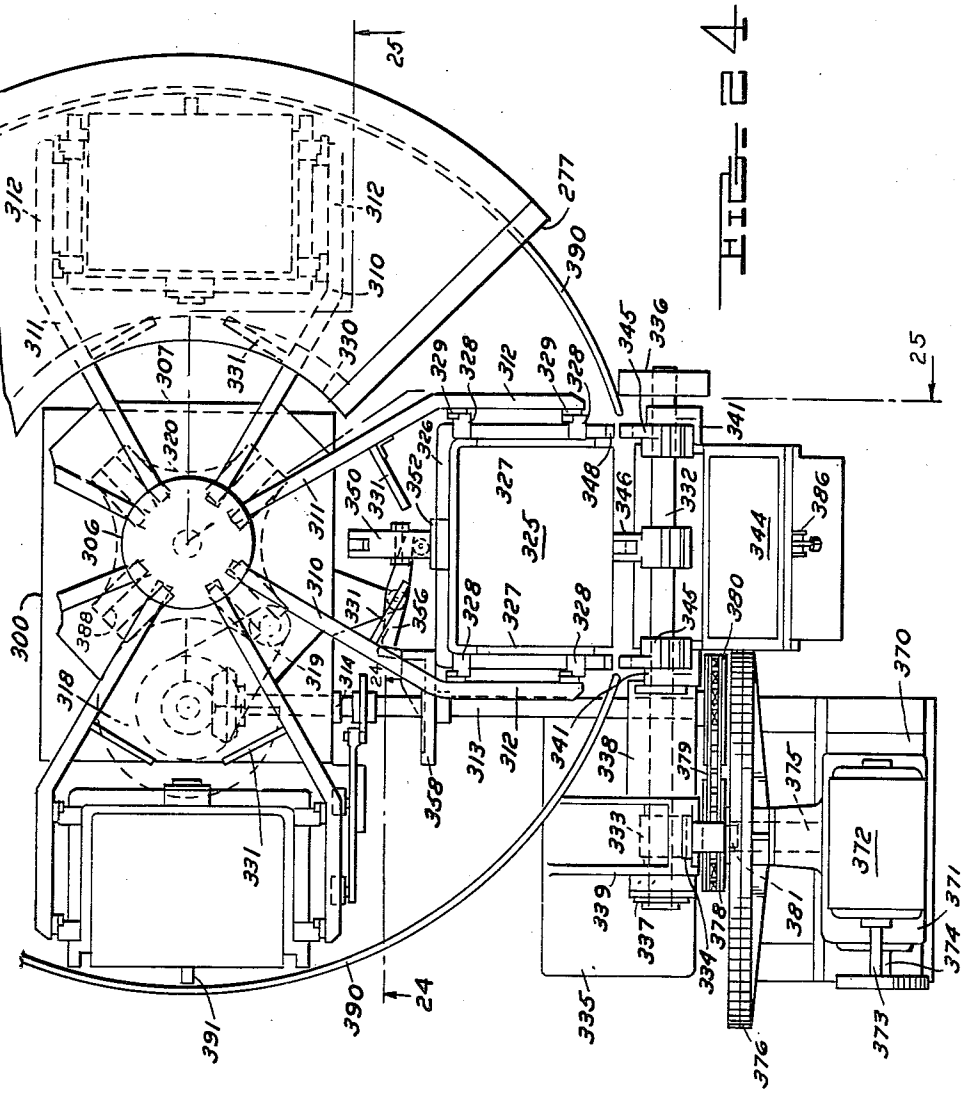
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TURNTABLE TYPE MACHINES FOR FORMING SHELL MOLDS

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FIG. 24



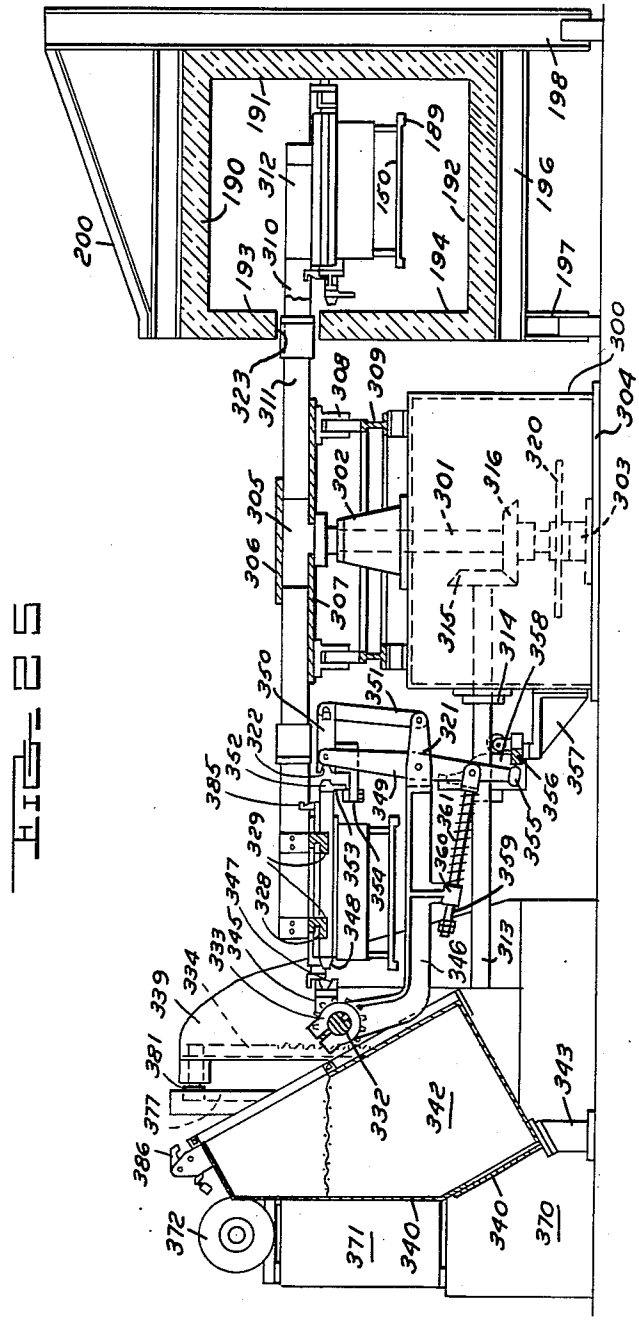

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TURNTABLE TYPE MACHINES FOR FORMING SHELL MOLDS

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FIG. 25




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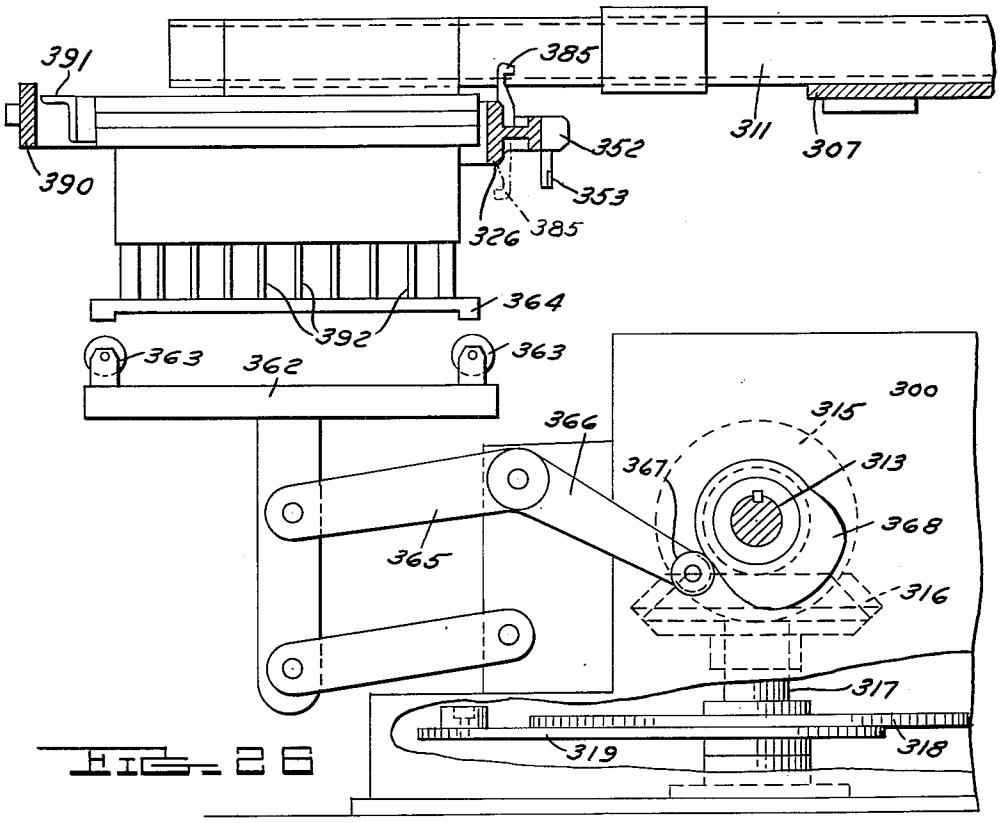



FIG. 26

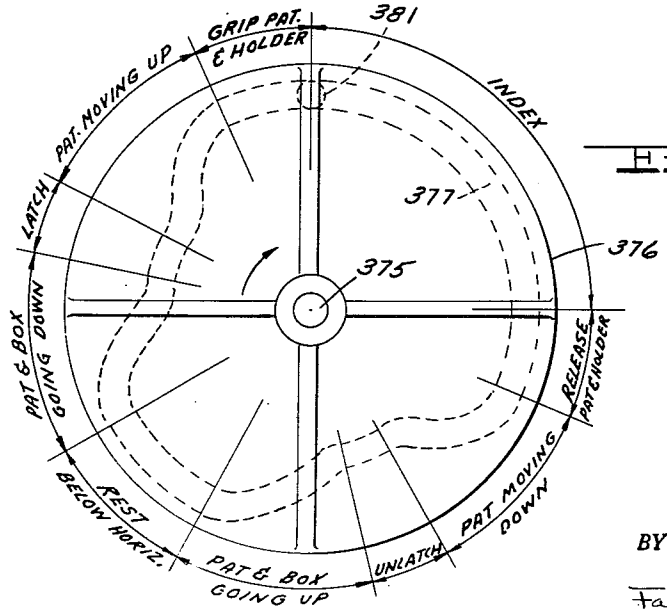



FIG. 27

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United States Patent Office 2,762,092 Patented Sept. 11, 1956



2,762,092

# TURNTABLE TYPE MACHINES FOR FORMING SHELL MOLDS

Paul Klamp, Detroit, and Leonard J. Bishop, Birmingham, Mich., assignors to Mechanical Handling Systems, Inc., Detroit, Mich., a corporation of Michigan

Application July 18, 1952, Serial No. 299,606

52 Claims. (Cl. 22—21)

This invention relates to machines for forming molds of the type known in the founding industry as shell molds, which are made by a process which involves the steps of depositing a layer of thermosetting mold forming material upon a heated pattern plate, curing the mold in an oven, and then stripping the mold from the pattern plate as the latter emerges from the oven, leaving the pattern plate in a heated condition to receive a new coating of mold forming material.

The term "turntable" is used to designate the type of machine of the invention due to the fact that the general arrangement of the machine involves the mounting of a plurality of pattern carriers, each adapted to receive a pattern plate, upon a turntable mounted for rotation on a vertical axis. Rotation of the turntable passes the pattern carriers by areas in which the essential steps of the shell molding process are performed, including a mold forming area, a stationary oven through which the pattern carriers travel for curing of the mold, and a mold stripping or ejector station.

The material of which the mold is formed is held in a container having an opening adapted to be covered by a pattern plate during the mold forming operation. With this opening so covered, the container is inverted over the pattern plate to deposit mold forming material all over the heated surface thereof, and then, the pattern plate is positioned above the container so that the excess material falls back into the container. This method of applying the mold forming material has been found to be perhaps the most satisfactory devised at the present time because it keeps the mold forming material under confinement, a feature very necessary due to the powder-like, dust-forming nature of the material.

This general method has been followed in machines previously constructed. For example, in one such prior machine of the turntable type, the mold forming material is applied by:

1. Turning the heated pattern plate upside down;
2. Moving a separate mold material container upward against the pattern plate;
3. Clamping the container to the pattern plate or pattern plate holder;
4. Lowering the container support to provide space for turning the container upside down;
5. Inverting the clamped container-pattern plate unit, superimposing the container above the pattern plate to deposit mold material over the surface of the pattern plate;
6. Reversing the position of the clamped unit again, moving the container below the pattern plate with the excess mold material falling back into the container;
7. Raising the container support until it contacts the bottom of the container;
8. Loosening the clamps;
9. Lowering the container; and
10. Turning the pattern plate right side up again.

A machine operating in this fashion has several inherent disadvantages. First of all, the large number of



successive motions of the various parts requires a large number of operating mechanisms and controls. Secondly, the hinge axis for inverting the pattern plate and mold material container is in such proximity to the pattern plate that it is not possible to move the pattern plate through an oven for curing the mold resting on the pattern plate, without moving the hinge bearings and some of the operating mechanisms for inverting, such as gears and racks, through the same oven, too. This makes it impossible to maintain proper lubrication on the bearing surfaces of the operating parts, and more heat is lost from the oven, being carried out by such parts. Furthermore, turning the pattern plate upside down after the mold material has been deposited thereon creates a tendency of parts of the newly formed mold to fall off.

Finally, when the pattern plate and container of mold material are inverted to the position where the pattern plate is below the container, the mold forming material is not level. Its upper surface is inclined at the angle of repose, usually 35 to 40°. Consequently, one side of the level pattern plate is covered to a lower height than the other side, resulting in lack of uniformity of the product.

The present invention, therefore, is directed to correcting these more obvious disadvantages together with the attainment of additional new and useful features for these machines by a new combination and arrangement between the parts which comprise a molding unit, that is, a pattern carrier and molding material container and between a molding unit, a turntable, an oven, and mechanism for motivating the parts.

The more important features of the invention are: first, a mold forming unit wherein the pattern carrier and material container are hinged for movement about a common axis, this axis being located remotely from the position of a pattern plate in a carrier, and located remotely from the oven of the machine. This results in a much simplified operation of the parts. In combination with the oven design it enables all major operating parts of the machine to be kept out of the oven heat. In combination with a new design of material container, it enables the amount of motion of the parts to be reduced considerably and, at the same time, results in greater uniformity of the finished product.

Second, a pattern carrier mounted on a turntable which supports the pattern plate in a normal horizontal position projecting outwardly from the circumference of the turntable, in combination with a semicircular oven arranged around the turntable and having a continuous slot in its vertically disposed inner wall. The pattern carrier projects into the oven through this slot and positions the pattern plate within the oven. Means are preferably provided to seal the vertical slot in the oven wall. This arrangement subjects a minimum number of parts of the machine to the direct heat of the oven and also improves the efficiency of the oven by reducing the heat loss through radiation and also through the amount of heat absorbed by the parts passing through the oven.

Third, a motivating mechanism and arrangement for moving all of the parts of the machine through their cycle from a single source of motive power so that the machine operates as a single geared unit in contrast to a unit employing multiple sources of motive power with necessary interlocking controls for governing the sequence of operation.

Fourth, basic relationships between the principal parts of the machine, as briefly outlined above, which can readily be applied to the construction of machines of various sizes, having varying capacities and rates of production.

Many other features are present in the machines of

the invention which can only best be appreciated from a consideration of specific constructions. These features and the main features pointed out above are incorporated in the machines illustrated in the accompanying drawing and to be described herein. In general, these machines comprise two general types, the first, a continuously rotating turntable machine shown in Figs. 1 to 18 of the drawings, with a modification of this type being illustrated in Figs. 19 to 23 thereof. The second construction is an intermittently operating turntable type machine illustrated in Figs. 24 through 27.

The individual views comprising these drawings are described as follows:

Fig. 1, a plan view of the machine showing the turntable, its driving mechanism, the oven, the ejector, and two of the pattern carrier-container molding units. In the actual machine, these mold forming units are duplicated at equal intervals around the circumference of the turntable, the complete number being eliminated from this figure in order that other constructional details of the machine would be apparent;

Fig. 2, a sectional view of the machine taken along the line 2—2 of Fig. 1 showing half of the turntable, its supporting structure and drive unit, and the relationship between turntable and oven and between the carrier and container components of the mold forming unit while the carrier is conveying the mold through the oven;

Fig. 3, a sectional view taken along the line 3—3 of Fig. 1 showing the relationship between carrier and container as a mold forming unit carried by the turntable passes the location of this section line;

Fig. 4, a section taken along the line 4—4 of Fig. 1 showing the relationship between carrier and container as a mold forming unit passes this section line, the container being inverted over the carrier. Position of carrier and container at maximum degree of inverted movement, is indicated in phantom. The mold forming unit occupies this position a few degrees of turntable rotation in advance of the location of the section line 4—4;

Fig. 5, a section taken along the line 5—5 of Fig. 1 showing the relationship between the container and carrier of a mold forming unit and the relationship between the latter and the ejector mechanism as this mechanism is operating to strip a mold from a pattern plate;

Fig. 6, a side elevation of the ejector mechanism shown in Fig. 5, the pattern carrier being sectionalized in this view to more clearly illustrate the operation of the parts during stripping;

Fig. 7, a section taken along the line 7—7 of Fig. 1 illustrating the construction and operation of a feeding device for replenishing the supply of mold forming material, and also illustrating the relationship between the carrier and container units while passing the location of this section line;

Fig. 8, a detail taken along the line 8—8 of Fig. 7 showing a cam controlled device for actuating the feeder mechanism;

Fig. 9, an enlarged detail in plan taken in the direction of the arrows 9—9 of Fig. 4 showing a camming device for permitting movement of the mold forming unit to the maximum inverted position indicated in Fig. 4;

Fig. 10, a plan view, partly in section, containing an enlarged showing of a pattern carrier with a pattern plate mounted therein;

Fig. 11, an enlarged detail taken along the section line 11—11 of Fig. 10;

Fig. 12, an enlarged detail taken along the section line 12—12 of Fig. 10.

Fig. 13, a sectional detail of the mold forming unit support taken along the line 13—13 of Fig. 10 and showing this support in assembled relationship with the turntable;

Fig. 14, an enlarged detail taken along the line 14—14 of Fig. 10;



Fig. 15, a sectional detail taken along the line 15—15 of Fig. 10;

Fig. 16, a side elevation taken along the line 16—16 of Fig. 1 showing a cam track for controlling pivotal movement of the carrier and container of a mold forming unit during the mold forming operation;

Fig. 17, an enlarged detail of a cam actuated latch for engaging a pattern carrier to a container during the mold forming operation. This latch is shown in engagement in Fig. 3 and Fig. 4, and continues to be engaged until the container has been returned to its normal position such as shown in Fig. 7;

Fig. 18, an enlarged side elevation taken in the direction of the arrows 18—18 of Fig. 1 and showing the cams employed for actuating the latch shown in Fig. 17;

Fig. 19, a plan view of an alternate form of continuously rotating turntable type machine showing the mold forming segment thereof. In this view, the molding units are indicated in phantom, and many details previously illustrated in the machine of Figs. 1 to 18 are eliminated for the sake of simplicity and clarity;

Fig. 20, an elevation showing the cam track for controlling the mold forming operation of the machine of Fig. 19;

Fig. 21, an elevation taken along the line 21—21 of Fig. 19 showing the material container and pattern carrier in the relative position occupied at the beginning of the mold forming cycle;

Fig. 22, an elevation taken along the line 22—22 of Fig. 19 showing the relationship between the parts of the mold forming unit at the position of this section line;

Fig. 23, an elevation taken along the line 23—23 of Fig. 19 showing the relationship between the parts of the machine after the mold forming operation has been completed and the pattern carrier has passed into the oven;

Fig. 24, a plan view of an intermittently rotating turntable type of machine of the invention. Three of the four stations of this machine are shown, the fourth station not being illustrated in full due to the fact that in this particular machine that station is a second curing station where the parts are in the oven in the same manner as are the parts shown in dot-dash lines;

Fig. 25, an elevation taken along the line 25—25 of Fig. 24 and showing in section both the mold forming station of the machine and one of the curing stations;

Fig. 26, an elevation taken along the line 26—26 of Fig. 24 showing the ejector station and a portion of the turntable drive of the machine; and

Fig. 27, an end elevation of the cam which operates the parts through the molding cycle.

In the following detailed description of the invention the two general constructions—continuously rotating turntable machine and intermittently rotating turntable machine will be described separately under these general headings.

## CONTINUOUSLY ROTATING TURNTABLE MACHINE

(Figs. 1 to 23)

Due to the relative complexity of this machine, it is believed that a more adequate and understandable description of the construction thereof can be obtained by considering its major component parts individually. This is particularly true because of the fact that the constructional features of many of these major parts are common to the invention regardless of the size of the machine or whether the machine employs a continuously or intermittently rotating turntable. These common or basic features of the invention, will, as far as possible, be pointed out in connection with the description of the construction of each component part. This description will then be amplified by an over-all description of the operation of the machine.

*Turntable and drive unit*

(Figs. 1 and 2)

The turntable consists of a pair of hub plates 21 and 22 each connected to a number of spokes 23 which extend radially from the center of the turntable at equal intervals. A center bearing 24 is carried by the lower hub plate 22 and receives a spindle 25 forming part of a pedestal assembly 26 which defines the rotational axis of the turntable. At their outer ends each adjacent pair of spokes 23 are interconnected by a channel member 27 secured to their upper flanges, and by a sprocket segment 28 secured between a roller 29 and spacer 30, to their lower flanges. A circular rail 31 is positioned beneath the rollers 29 and supports the major portion of the weight of the turntable. The channel member 27 serves as a support for each of the molding units and each of these channel members is braced by a sheet metal panel 32 having one end secured to the upper flange 33 of the channel member 27 and its other end secured between the upper flanges of an adjacent pair of spokes 23. The panel member 32 also acts to define and support the container in its normal position and is provided with a supporting pad 34, preferably of resilient material, which is contacted by the container.

When the foregoing parts of the turntable are assembled, the sprocket segments 28 together form a complete circular sprocket positioned below the spokes of the turntable, and a caterpillar type of driving unit is provided to rotate the turntable by engagement with this sprocket. This drive unit, which is formed of conventional components, is not shown in detail, but its major parts are illustrated in Fig. 1 and comprise a motor 40, coupled by a shaft 41 and overload clutch 42 to a reducer 43. The output shaft of this reducer extends vertically and is provided with a driving sprocket 44. A driving chain 45 is trained around this sprocket and around a similarly disposed sprocket 46 forming part of a take-up unit 47. A portion of the chain 45 intermediate the driving and take-up sprockets engages the sprocket segments 28 of the turntable and a backup roller 49 is preferably employed to maintain the chain in driving engagement with the sprocket segments 28 and to define a sufficient degree of wrap-around.

This driving unit, then, is thus adapted to rotate the turntable on its supporting spindle 25 and supporting rollers 29. The principal component parts of the machine carried by the turntable and rotating therewith are the molding units. Other major component parts such as the oven, ejector and feeding mechanism are stationary.

*Molding unit*

Each molding unit consists of a support assembly, a pattern carrier, and a container for holding a quantity of mold forming material, the carrier and container being pivotally mounted upon a support assembly. In this machine, the support assembly is secured to the turntable.

Considering first the support assembly, and comparing Figs. 3, 13 and 10, the main member of this assembly is a cast pedestal member 50 formed with a housing 51 of semicircular cross section at its upper end. The lower portion of the housing is provided with two vertically extending flanges 52 (Fig. 3) adapted to straddle the outer face of a channel 27 of the turntable, and the housing is attached to the channel 27 at a location midway between a pair of adjacent spokes 23 of the turntable by bolts 53 (Fig. 13). A pair of bearings 54 are mounted in holes 55 formed in the side faces of the housing 51 and support a pivot shaft 56. A gear segment 57 is keyed to the shaft 56 and located within the housing 51. This gear segment 57 engages a rack 58, which is T-shaped in cross section (Fig. 10), and which is provided with teeth 59. A pair of vertically extending gibs 60 are secured to the outer vertical face of the



pedestal 50 by screws 61, these gibs being located within shoulders 62 formed in such outer face and bordering a vertical slot provided therein. The T section of the rack bar 58 slidably engages these gibs 60 and its teeth 59 engage the gear segment 57. A roller cam follower 63 is secured to the lower end of the rack bar 58, this cam follower contacting a control cam during the mold forming portion of the cycle of the machine to produce vertical movement of the rack bar 58 and consequent rotation of the pivot shaft 56.

Referring to Fig. 13, movement of the rack bar 58 in a downward direction is normally limited by a slide 64 which is held within the channel-shaped base 65 of the pedestal 50 by a plate 66. A cam roller follower 67 is secured to the inner end of the slide 64 by a downwardly extending bracket construction 68. When the slide 64 and rack bar 58 are in the normal position shown in Fig. 13, a limited degree of interengagement is provided between these parts by a detent 69.

The pattern carrier, best illustrated in Fig. 10, is constructed to form a rectangular open framework adapted to receive a pattern plate 70. This framework is defined by left and right side arm members 71 and 72, respectively, interconnected by a member 73 which forms the inner end wall of the frame. Each side arm extends inwardly past the end wall 73 and is provided with a split hub 74 adapted to engage a portion 75 of the pivot shaft 56 and be connected for rotation therewith by a key 76. The outer end of the framework is formed by an end gate 77 which is hinged to the left-hand side arm 71 at 78 and carries a pivoted latch 79 and latch lever 80 which engage a striker 81 secured to the end of the right-hand side arm 72 by bolts 82.

A pattern plate slide 83 is pivotally secured to each of the side arms 71 and 72 by a construction illustrated in the detail Fig. 11. Each of the slides 83 is formed with a longitudinally extending inwardly facing groove 84 dimensioned to receive a projecting rib 85 formed on the sides of the pattern plate 70 and is connected to the side arm 71 by a pin 86 having an enlarged head 87 eccentrically formed with relation to the center of the pin 86 as illustrated in Fig. 14. An adjusting and locking bar 88 (Fig. 11) is seated within a notch 89 formed in the portion of the pin which projects outwardly through the side arm 71 and is connected to the pin by a bolt 90. This bar serves to locate the pin 86 axially, and also serves to define the rotational position of the pin through the engagement of the locking bar with a pair of adjusting screws 91 which are threaded in holes 92 formed in an outwardly projecting flange 93 of the side arm 71. Through the adjustment of these screws 91, the pin 86 can be rotated to adjust the position of the pivotal axis of the slide 83 (defined by the eccentric head 87 of the pin) relative to the side arm 71. Pivotal movement of each slide 83 about this pivotal axis is limited as shown in Fig. 12, by a bolt 94 engaging a hole 95 and carrying a spacer 96, both bolt 94 and spacer 96 being received in an enlarged hole 97 formed in the side wall of the side arm 71.

An upwardly projecting latch dog 100 is pivotally carried between a pair of lugs 101 secured to the inner wall of the end gate 77. The upwardly projecting position of the latch dog 100 is defined by engagement between a surface 102, formed on its inner side, and a positioning boss 103 formed on a pattern plate 70. Thus, when a pattern plate 70 is not positioned within the pattern carrier framework, the latch 100 is free to fall into a downwardly extending inoperative position (see Figs. 2 and 17), and can be left in this position, if desired, when a pattern plate is inserted in the carrier so that such carrier will cycle without forming a mold.

Construction of the mold material container, generally indicated by the reference 110, may be understod from a comparison of the plan view thereof shown in Fig. 1 with the side elevation such as shown in Fig. 2. This

container is of sheet metal construction built around a pair of side frames **111** extending along either side of that portion of the container which will be referred to as its upper surface **112** or top. The container includes a pair of side walls **113**, a bottom wall **114** and inner and outer end walls **115** and **116**. A cleanout panel **117** is detachably secured to the bottom wall **114** along the inner end thereof. An opening **118** is provided in the top wall **112**, this opening being defined by a frame of interconnected tubing members **119** of rectangular cross section, and a rectangular sealing plate **120** is secured to the outer surfaces of these members **119**. The container construction includes an internal baffle **121** of mesh material.

In over-all construction, the container may be considered to be composed of two sections, one, a material transfer section generally indicated in Fig. 2 by the reference **127** and the other, a storage section, generally indicated in this view by the reference **128**. The volume of the container comprising the material transfer section may be considered as that adjacent the rectangular opening **118**. Referring to Fig. 4, where the container is shown with the opening **118** in a horizontal position, the material transfer section comprises that portion of the container located above the area of the opening. The remaining volume of the container comprises the storage section. As will be more thoroughly appreciated when the operation of the machine is discussed in detail, this sectionalized construction of the container requires a lateral movement of material from the storage section to the discharge section in passing into or out of the opening **118**.

This container is mounted upon the pivot shaft **56** of the support assembly by a pair of brackets **122**, each bracket being secured to one of the side frame members **111** of the container by bolts **123**, and each bracket including a bearing hole **124** carrying a bushing **125**. The pivot shaft **56** is provided with portions **126** which engage the bushings **125** so that the entire container **110** is rotatably mounted thereon.

A toggle type latch assembly, generally indicated by the reference **130**, is secured to the outer end wall **116** of the container. Details of the construction of this latch assembly are shown in Fig. 17 together with the manner in which this latch operates to engage the latch dog **100** carried by the end gate **77** of the pattern carrier. The principal parts of this assembly consists of a latch handle **131** and a latch **132** which is pivotally secured to the handle **131** by a pin **133**. A U-shaped bracket having two sides **134** and a channel-shaped end section **135** carries a pivot pin **136** for mounting the latch handle **131** and a second pin **137** engaging a slot **138** formed in the latch **132**. In Fig. 17, the parts are shown in full line in the unlatched position, latched position being indicated in phantom. Latching and unlatching movement of the latch handle **131** is controlled by the engagement of a roller type cam follower **139** carried by the latch handle with a pair of cam bars **140** carried by a stationary framework to be hereinafter described.

Figure 17 also discloses additional details of the construction and mounting of the latch dog **100**, including the previously mentioned engagement between its surface **102** and the boss **103** of a pattern plate, the shape of the mounting lugs **101** in side elevation, and the fact that the latch dog **100** is carried by a pivot pin **104** whose ends are received in slotted holes formed in each of the lugs **101** and engaged by a pair of adjusting screws **105** so that the position of the pivot pin **104** can be changed relative to the end gate **77** of the pattern carrier, or more particularly, relative to the rectangular sealing flange **106** forming part of the construction of each pattern plate **70** and which is adapted to engage the sealing frame **120** of the container **110**.

This sealing engagement between the flange of a pattern plate and the frame bordering the opening in the container takes place during the mold forming operation. Each molding unit, consisting of the support assembly, the pattern carrier and the container rotate with the turntable of the machine, and, except during that segment of their travel when the mold forming operation is performed, the pattern carrier and container occupy what may be termed normal positions. These normal positions are shown in Figs. 2 and 7, which show the positions occupied by the pattern carrier and container while passing through the oven for the curing operation, and in Fig. 3, which shows these parts in the position they occupy during the ejecting or stripping operation. These views show that the normal position of the pattern carrier is one wherein its side frame arms **71** and **72** extend outwardly from the center of rotation of the turntable in a substantially horizontal attitude, and in this position, the mold forming surface **141** of the pattern plate (Fig. 2) is directed upwardly. The normal position of the container is one where its end wall **115** rests against the bumper **34** carried by the plate **32** of the turntable, and its opening, bordered by the sealing frame **120**, is directed upwardly and outwardly from the center of the turntable.

*Pattern plate assembly*

The pattern plate is an assembly consisting of a pattern plate **70** and a knockout plate, movably connected to the pattern plate by a number of guides, and carrying a suitable number of knockout plungers. This assembly is shown in plan in Fig. 10 in the relationship it occupies with the pattern carrier, and in end elevation in Fig. 6 with the knockout plate in. A detail of the construction of a guide and knockout plunger is shown in Fig. 15.

As previously mentioned, the pattern plate **70** is bordered by a sealing flange **106** (Fig. 10). Within this flange as a border, the plate is shaped to the pattern desired. The plate is provided with depending end and side walls **144** and **145** which terminate in bosses **146** located adjacent each corner of the plate. A headed guide pin **147** is slidably mounted in each of these bosses, its headed end **148** being seated in a recess formed in the plate **70** so as to lie flush with the surface thereof. A stud **149** is formed on the opposite end of the guide pin **147** and serves to connect the pin to a knockout plate **150**. Other bosses **151** depend from the surface of the plate **70** (Fig. 15) and are each drilled to slidably receive a knockout pin **152**. Any number of these knockout pins may be used in a particular assembly, depending upon the nature of the pattern, each pin being conected to the knockout plate **150** by a stud **153** and nut **154**. This nut **154** together with a nut **155** which engages the stud **149** of each guide pin **147** are seated in recesses formed in the lower surface **156** of the knockout plate.

During the ejecting operation the knockout plate is caused to be moved upwardly relative to the surface of the pattern plate **70**, as shown in Fig. 6, and, to insure return movement to a normal position such as shown in Fig. 15, a number of return springs **157** are mounted around a number of the knockout pins **152**, these springs being positioned between the inner surface **158** of the knockout plate and the inner surface **159** of the boss **151**.

Referring to Fig. 10, the inner end wall of the pattern plate is provided with a pair of locating bosses **160** which are adapted to register against the end wall **73** of the pattern plate carrier. Another locating boss **103** is formed on the outer end wall of the pattern plate, this boss being adapted to register against the surface **102** on the latch dog **100**. The side walls **145** of the pattern plate (Fig. 15) carry the flanges **85** which engage the pattern carrier slides **83**.

*Ejector*

The ejector is shown in side elevation, looking away from the center of the machine, in Fig. 6 and in end elevation in Fig. 5, both of these views showing the ejector in its actuated position. It is a unit consisting of a sup-

porting frame and a roller table movable vertically relative thereto. The frame consists in a pair of side rails **165**, connected at one end by a cross member **166**, and each carrying a vertical panel **167** at the other end. Each of the panels **167** is reinforced by an upright member **168** of angle cross section and the two brackets **167** are interconnected by a transverse sheet metal end member **169**. A pair of inner and outer upper arms **170** and inner and outer lower arms **171** are each pivotally secured to the uprights **168**, with each pair of arms **170** and **171** being interconnected by transversely extending channel members **172** and a plate **173**. The arms are pivotally connected to inner and outer upright members **174**, the upper arms **170** being pivotally secured to a cross shaft **175** and the lower arms to a cross shaft **176**. The cross shafts are located so that a parallel relationship is defined between each pair of arms **170** and **171**.

Diagonal members **177** (Fig. 5) interconnect the upright members **174**, as do transverse angles **178**. A horizontally extending platform **180** is connected to the upper ends of the uprights and braced by a pair of gusset plates **181**. Two series of rollers **182** and **183** are mounted in brackets **184** carried by the platform **180**, the rollers in each series having their rotational axes located substantially radially with reference to the center of rotation of the turntable of the machine, with each series being arranged arcuately with respect to the center of rotation of the turntable (see Fig. 1).

This mounting of the platform **180** allows it to move vertically in a horizontal position. Such vertical movement is obtained by a cam **185** carried by the inner upper arm **170**, and the ejector is located with reference to the turntable in a position such that the lower or working surface **186** of the cam will be contacted by the roller cam follower **63** of the support assembly of each molding unit as such molding unit moves past the ejector. Normal or rest position of the ejector is defined by the engagement between an elevation controlling screw **187** and a cross member **188** extending between the side frame members **165**.

The rollers **182** and **183** contact a depending flange **189** formed along the edges of the knockout plate **150**.

*Oven construction*

The oven is rectangular in cross section and extends around more than half of the circumference of the turntable as can be seen from Fig. 1. Details of its construction are best shown in Figs. 2 and 7. It has an upper wall **190**, an outer wall **191**, a bottom wall **192**, and an inner wall formed of two separate portions, an upper portion **193** and a lower portion **194**, the adjacent ends of these portions **193** and **194** being separated to form a continuous slot around the entire inner side wall of the oven. The bottom wall of the oven is supported on a series of horizontal beams **196**, each resting on an inner leg **197** and being connected to an outer upright **198** which extends beyond the top wall of the oven. Each of the uprights **198** carries a cantilever beam **199** which supports the upper oven wall **190** and which is braced in position by a diagonal **200**.

A series of upper gas burners **201** and lower gas burners **202** extend throughout the length of the oven and a series of exhaust ducts **203** communicate with the interior of the oven through the top wall **190** thereof, these ducts being connected by a manifold **204** to an exhaust stack, preferably equipped with a blower (not shown). This duct system is provided to insure combustion, to remove offensive odors accompanying the curing of the molding material, and to afford some control over the heat transfer from the oven to the working area surrounding the machine and particularly to the operating parts of the machine. Additional control over heat transfer is provided in the form of baffle plates of insulating material. These baffle plates are indicated in Fig. 10 and consist in one plate **206** connected to the inner end wall **73** of each pattern carrier by studs **207** and adjacent plates **208** which are carried by and rotate with the turntable portion of the machine. These baffle plates are positioned to substantially fill in the slot formed in the inner side wall of the oven and thus minimize the amount of heat that may escape through that opening.

*Feeder mechanism*

This mechanism is carried by the oven structure and is shown in Fig. 7 and is provided to replenish the supply of the pulverant mold forming material carried within the container. An auger-type conveyor **210** extends over the machine and terminates in a spout **211**, the end of which overlies a discharge hopper **212** having a discharge spout **213**. The hopper **212** is pivotally carried between a pair of brackets **214** carried by an oven supporting beam **199**, and is positioned so that the spout **213** of the hopper closely overlies the opening **118** of each of the containers passing this station. In Fig. 7, the hopper **212** is shown in full line in a receiving position and in dotted line in a discharge position, and its pivotal movement between these positions is in response to the actuation of a fluid pressure cylinder **221** pivotally carried by a bracket **222** mounted upon a member **223** supported by the upper beam **199** of the oven. The free end of the rod **220** of the actuating cylinder **221** is pivotally secured to the hopper.

Operation of the fluid pressure cylinder **221** is controlled by a three-way valve assembly **225**, shown in detail in Fig. 8. This assembly consists of a plate **226** mounted on one of the supporting legs **197** for the oven and carrying a pivoted lever **227** and either a suitable valve **228** or a solenoid, adapted to be actuated by a plunger **229**. The lever **227** and valve assembly **225** is positioned so as to be contacted by the roller cam follower **63** of each molding unit. When this valve assembly is actuated by the passage of a molding unit, a resultant actuation of the fluid pressure cylinder **221** takes place, producing a movement of the hopper **212** to the discharge position indicated in dotted line. After the roller **63** moves out of contact with the lever **227**, a spring **230** returns the lever to the dotted position, allowing the valve (which is of the spring loaded type) to return to its other position and returning the hopper to receiving position.

*Cooling system*

This system is preferably included for controlling the temperature of certain critical parts of the machine. These parts are the bearings and gear segment of the molding unit assembly and the sealing frame **120** of the container. Coolant is circulated to these parts through supply lines **231** and **232** (Fig. 2), line **231** being the inlet passage and line **232**, the outlet. These lines are secured to a fitting **233**, located on the rotational axis of the turntable, inlet line **231** being extended through the fitting **233** so that concentric passages are formed which are connected to the concentric passages of a commercial type of rotary joint **234**. A cylindrical manifold, comprising an inlet section **235** and an outlet section **236** separated by a baffle **237**, is mounted upon the upper hub plate **21** of the turntable, and the rotary joint **234** is connected to this manifold. The inner passage of the rotary joint connects with the inlet section **235** of the manifold, and the outer concentric passage of the joint is connected by a U-shaped line **243** to the outlet section of the manifold. The manifold and rotary joint **234** rotate with the turntable, while the supply lines **231** and **232**, together with the fitting **233** are stationary.

A branch line **238** leads from the inlet manifold **235** to a three-way swivel joint **239** secured to one end of the pivot shaft **56** of each molding unit (Fig. 10). The pivot shaft **56** is formed with a hollow center providing a passage **240** between its ends, and communicating with another three-way swivel joint **241** secured to the opposite end of the shaft. A return line **242** leads from

this three-way swivel joint 241 to the return manifold 236. At the three-way swivel joint 239 a portion of the coolant is diverted through a line 244 leading to a connection 245 on one side of the tubular frame member 119 of the container unit. A similar connection is provided at the opposite side of this tubular frame and a line 246 leads therefrom back to the swivel joint 241 at the other end of the pivot shaft 56.

Thus, coolant circulates through the shaft 56 to carry away heat transferred thereto through the side arms 71 and 72 of the pattern carrier, and to the tubular members of the container unit to carry away heat transferred to the frame 120 thereof through contact with the pattern plate. The temperature control of the frame 120 is desirable due to the fact that the outer surface of this frame must be kept perfectly clean so that it may be positioned in firm sealing engagement with the sealing flange 106 of the pattern plate. If the temperature of the frame 120 is not controlled it is likely to rise to a point where the thermo-setting resin in the mold forming material would melt upon coming in contact with the frame and would adhere thereto and build up thereon; and, since the mold forming material is such a finely divided pulverant it is practically impossible to eliminate the presence of all material dust, which will settle over all parts of the machine and adhere thereto unless some means such as dust shields or temperature control is employed.

*Operation of machine and control cams*

The means employed for moving the pattern carrier and container unit of each molding unit through a mold forming operation have not been described, it being felt that this description would be clearer if coupled with a description of the operation of the machine in general. The complete cycle of the machine, with respect to any individual molding unit, will include the operations of mold forming, curing, and ejecting or stripping.

Referring to Fig. 1, this cycle of operation begins at a point just beyond the section line 5—5, with the turntable rotating in a counterclockwise direction. At this point, a molding unit which has just passed over the ejector has had its mold removed from the pattern plate thereby, and is ready to pass through that portion of the cycle of the machine during which a new mold is formed. A brief interval is provided between the end of the ejecting operation and the beginning of the next mold forming operation in order to allow the pattern plate to be cleaned and conditioned therefor if necessary. During this interval the pattern carrier is still projecting outwardly from the center of the machine in a horizontal position such as shown in Fig. 5.

The mold forming cycle begins at the position of the beam 250 shown in Fig. 1 just beyond the location of the section line 5—5 in the direction of rotation. This beam is located at subfloor level and extends radially inwardly toward the center of the machine beneath the track 31 and under the pedestal 26. Secured to this beam at a position radially outwardly from the circumference of the turntable is an upright stanchion 251 (Fig. 4). Two other similar beams 250 each carrying similar stanchions 251 are arranged at radial intervals from the position of the beam first mentioned, and an end view of these three beams and stanchions is shown in Fig. 16. A pair of cross members, upper 252 and lower 253, are rigidly secured to each stanchion 251, each cross member carrying a pair of clamping screws 254 provided with lock nuts 255. A mounting plate 256 is secured between each pair of cross members 252 and 253 upon each stanchion 251 by the clamping screws provided for this purpose, and upper and lower cam track members 257 and 258 respectively are secured to the mounting plates 256, the lower cam track 258 being formed as a continuous member and the upper cam track 257 being composed of two members having their adjacent ends each connected to the center mounting plate 256*a*. At intervals between the mounting plates, the cam track members are interconnected by C-shaped brackets 259. These cam tracks are spaced to receive the roller cam follower 63 on the support or pedestal assembly of each molding unit, and, referring to Fig. 16, travel of the roller cam follower 63 along the cam track is in the direction from left to right in this view.

As the roller 63 enters the cam track section, which extends around and defines the mold forming section of the machine, it first contacts the lower cam track 258 and is forced upwardly of the pedestal unit thereby. This upward movement of the cam follower produces an upward movement of the rack bar 58 and a clockwise rotation of the gear segment 57 as the parts are viewed in Fig. 13. Rotation of the gear segment 57 is accompanied by rotation of the pivot shaft 56 and produces a clockwise pivotal movement of the pattern carrier from the position shown in Fig. 5 to the position shown in Fig. 3, the section line for this latter view being taken immediately beyond the end of the upwardly inclined portion of the lower track member 258 at the left hand side of Fig. 16.

This movement superimposes the pattern carrier upon the container and, immediately prior to the completion of this movement the roller cam follower 139 of the toggle latch assembly 130 is moved to unlatched position through contact with the cam bar 140 and then moved to latched position after contact between the pattern carrier and container has been established. In Fig. 3, this latching movement has just been completed and the carrier has been secured to the container with the sealing flange of its pattern plate in firm engagement with the frame 120 of the container.

The roller cam follower 63, which is now in contact with the upper cam bar 257, enters the downwardly inclined portion 270 thereof and is forced downwardly, producing a downward movement of the rack bar 58 and opposite rotation of the gear segment 57, shaft 56 and pattern carrier keyed thereto. This movement of the pattern carrier is accompanied by a free pivoting of the container unit about the shaft 56, and after pattern carrier and container pass through the vertical, their weight forces the cam follower 63 into contact with the lower cam track 258. The lower cam track 258, along its portion 271 secured to the mounting plate 256*a*, extends below the level of its initial portion 272, and this results in a downward movement of pattern carrier and container to a position where the pattern carrier moves downwardly past its normal horizontal position to the dotted line position indicated in Fig. 4—a position produced by approximately 30° of rotation of the pivot shaft 56 past the normal or horizontal position of the pattern carrier. This movement is provided in order to insure that the mold forming material in the container will be evenly deposited over the entire surface of the pattern plate. In order for this movement to take place, the slide 64 (Fig. 13) of the pedestal assembly of the molding unit must be moved inwardly toward the center of the turntable so that the rack bar 58 and cam follower 63 will be free to move below the normal position illustrated in Fig. 13.

Referring to Figs. 4 and 9, an auxiliary cam track is provided to accomplish this inward movement of the slide 64. This auxiliary cam track is mounted on a pair of pedestals 280 positioned below the turntable and consists of a channel member having a pair of vertically extending flanges 281 spaced to receive the roller cam follower 67 secured to the slide 64, and shaped to withdraw the slide from its interfering position with the rack bar 58, hold it in such withdrawn position, and then return the slide to normal position after the rack bar has again been moved upwardly beyond the point of interference.

Upward movement of the rack bar takes place as the cam follower 63 travels along the next upwardly in-

clined section 275 of the lower cam track 258 and is accompanied by pivotal movement of the shaft 56, pattern carrier and container until pattern carrier and container again reach a position corresponding to that shown in Fig. 3. After reaching this position, another latch bar similar to the latch bars 140 previously mentioned, is provided to operate the toggle latch assembly 130 to unlatched position, leaving the pattern carrier free to be returned to its normal position as the roller follower 63 travels along the remaining downwardly inclined portion of the cam track. This normal position, in which the pattern carrier arms extend horizontally outward from the turntable, is maintained during the remaining portion of the cycle of the machine.

The pattern plate supported by the pattern carrier is assumed to have entered the mold forming stage in a properly heated condition and this temperature of the pattern plate causes an even layer of mold forming material to adhere to all the surfaces thereof. All excess material is returned to the container, the baffle of mesh material 121 being provided to break up any lumps.

It is to be noted that the mold forming operation is accomplished with less than 180° of movement required in order to bring the mold material container from its normal position to a position where it is superimposed over the upright pattern plate. At the same time, an extra 20 to 30° of rotation has been included to bring the container to a position below the horizontal for depositing mold forming material on the pattern plate. This extra degree of inverting movement compensates for the normal angle of repose of the material which would place the material at an approximate angle of 30 to 40° were the container merely moved to a horizontal position. In other words, the material container is moved below the horizontal in order to place the material level substantially parallel to the pattern plate surface and thus insure the application of an even coat to the pattern plate.

The reduction in pivotal movement of the parts is made possible largely through the design of the material container—the provision of the material storage section 128 thereof displaced laterally from the position of the material discharging section 127. When the material container is returned to its normal position after inverting movement, the excess material in the discharging section 127 is free to fall directly downwardly into the storage section 128.

After the mold forming operation has been completed a brief interval of travel of the molding unit is provided to permit the mold to be inspected and any necessary minor repairs to be accomplished before it enters the curing stage.

As the molding unit approaches the mouth 277 of the oven the arms 71 and 82 of the pattern carrier enter the slot between the upper and lower portion 193 and 194 of the oven inner wall, and the pattern plate 70 is positioned within the oven, while the remaining portion of the molding unit travels adjacent the outer surface of the oven inner wall. Thus, only that portion of the pattern carrier framework immediately surrounding the pattern plate is subjected to the direct heat of the oven. The principal moving parts of the molding unit located along the hinge axis defined by the pivot shaft 56 remain outside the oven and are further separated from the heat thereof by the insulating panel 206 carried by each pattern carrier and the adjacent insulating panels 208 which extend between each two adjacent pattern carriers and are supported by the turntable framework. This separation of the principal moving parts from the oven heat, together with the coolant system provided for carrying away heat transferred to these moving parts by conduction, insures that their operation will not be adversely affected by the curing process.

During the travel of the molding unit through the curing stage, the supply of molding material in the container is replenished through the operation of the feeder mechanism, as controlled by the passage of a molding unit by the feeder station.

When the pattern carrier emerges from the oven, the curing of the mold has been accomplished, and the mold, while still in a heated condition, has been formed into a rigid unit which can absorb normal handling without likelihood of damage. This quality of the mold, when cured, permits the location of the ejector unit immediately adjacent the discharge end of the oven, and as a molding unit passes the ejector, the roller cam follower 63 of the molding unit contacts the cam surface 186 of the control cam 185 producing an upward movement of the ejector table and upward movement of the knockout plate 150 of the pattern assembly as this knockout plate travels along the two series of rollers 182 and 183 on the ejector table 180. The accompanying movement of the guide pins 147 and knockout plungers 152 strips the mold from the pattern and the mold can then be removed from the pattern carrier either manually or by suitable mechanical equipment.

This completes the cycle of operation of the machine. The pattern plate, having just emerged from the oven, is in a properly heated condition to receive a new charge of material during the ensuing molding cycle.

Operation of the modified construction shown in Figs. 19 to 23 is similar, and since the modifications have to do solely with the manner of controlling the position and movement of the parts of the molding unit, these modifications will be outlined briefly at this point.

The pedestal or support assembly 50*a* for the molding unit in this construction is secured to the rim channel member 27 of the turntable in the same manner as previously described for the pedestal assembly 50. The assembly 50*a*, however, does not include the rack and gear sector but merely supports a pivot shaft 56*a* and includes a stationary roller 282 in place of the roller 63. The pattern carrier is similar in construction to that previously described, its arms 71*a* and 72*a* being keyed to the pivot shaft to stabilize the carrier frame. A depending arm 283, mounting a roller 284, is secured to the carrier frame, as is another roller 285 to the carrier end gate 77*a*. The container unit 110 is identical to that previously described, and is pivoted on the shaft 56*a*.

In this construction the normal horizontal position of the pattern carrier is defined by the engagement of the roller 285, carried by the end gate thereof, with a circular supporting track 286 which extends around the entire circumference of the machine except for the mold forming segment thereof. Along the ejection segment of the circumference, the supporting track 286 is supplemented by a second supporting track carried above the track 286 on brackets 287, and the roller 285 extends between these two tracks to positively prevent any upward movement of the carrier during the ejecting operation.

At the end of the ejection segment, the roller 284, mounted on the crank arm 283 of the carrier, contacts a main cam bar 288 which takes over the function of supporting the carrier and defining its position. Fig. 21 shows the relationship of the parts at this time, with the roller 285 still in contact with the supporting track 286 and the roller 284 in contact with the initial portion of the cam bar 288. Cam bar 288 is shaped to produce pivotal movements of the carrier and container of the molding unit similar to those previously described. The first portion of this movement consists in rotating the carrier into juxtaposition with the container, as shown in Fig. 22, and during the last portion of this rotation a second cam bar 289 is employed to define the position of the carrier in a manner similar to the operation of the upper cam track shown in Fig. 16 and previously described. Similar cams are employed to operate the

roller follower of the container latch assembly to lock the pattern carrier to the container.

From the position shown in Fig. 22, the pattern carrier and container are rotated clockwise to the molding material depositing position, which is preferably below the horizontal and is defined by the portion **290** of the cam bar **288**. This movement is followed by a return of the parts to the position of Fig. 22, along the section **291** of the cam bar, when the latch is opened to separate the carrier from the container and allow the former to be moved back to its normal horizontal position. At this point the supporting track **286** picks up the roller **285** and supports the carrier in a horizontal position during its movement through the oven for curing of the mold.

This modified arrangement offers additional mechanical advantage for moving the parts of the molding unit through their cycle and offers more positive support for the pattern carrier, which features are advantageous in larger machines where the weight of the parts becomes a more important factor.

## INTERMITTENTLY ROTATING TURNTABLE MACHINE

(Figs. 24 to 27)

This machine illustrates the application of the invention to the construction of smaller units, the machine illustrated having four stations, molding, two curing and ejecting. Only three of these stations are shown in the plan view of Fig. 24, the fourth station being the second curing station where the pattern carrier is positioned within the remaining portion of the oven which occupies approximately 180° of the circumference of the machine.

Except for size, this oven is identical in construction to that previously described and identical reference characters have been employed to designate its various structural components.

### *Turntable*

In this machine the turntable is mounted on top of a housing **300** for rotation with movement of a vertical shaft **301** carried between a bearing **302** on top of the housing and a bearing **303** mounted on the bottom wall **304** thereof. This shaft **301** is secured to a hub member **305** of the turntable, as are a pair of upper and lower hub plates **306** and **307** respectively. The upper hub plate **306** is of circular configuration, while the lower hub plate **307** is larger and roughly octagonal in shape. A number of rollers **308** are secured to the lower hub plate and ride on a circular rail **309** supported by the top of the housing.

Pairs of carrier supporting arms **310** and **311** are secured between the hub plates **306** and **307** and extend radially outwardly to form a roughly V-shaped framework, these arms terminating in substantially parallel portions **312**.

Drive of the turntable is through a main shaft **313** whose motivation will be described in conjunction with the description of the operation of this machine. The drive shaft **313** is displaced laterally from the center of the turntable as can be seen in Fig. 24, is supported in a bearing **314** carried by a side of the housing **300**, and projects within the housing. A beveled gear **315** is carried on the end of the drive shaft and mates with a second bevel gear **316** secured to a vertical shaft **317** shown in Fig. 26. This shaft **317** carries the cam segment **318** and driving arm **319** of a Geneva type intermittent drive, the slotted driven wheel **320** being secured to the main vertical shaft **301**. This drive indexes the turntable 90° for each complete revolution of the drive arm **319**.

A pattern plate **325**, similar in construction to the pattern plate assembly previously described, is positioned within a U-shaped frame member **326** which carries pivoted slides **327** for engaging the pattern plate (these slides **327** being mounted similar to the slides **83** of the former construction). Two supporting lugs **328** are secured to each of the parallel legs of the U-frame **326**. Each of these lugs engage a supporting bracket **329** carried in pairs on the parallel portion **312** of each of the supporting arms **310** and **311**, and positioned below the arms as shown in Fig. 25. Each bracket **329** is slotted to engage the upper, lower and inner surfaces of a lug **328**.

Each adjacent pair of arms **310** and **311** are joined by a section of baffle plate **330**, adapted to extend between the upper and lower walls of the oven slot **323**, and stub sections of baffle plate **331** extend oppositely from each arm **310** and **311** of a pair.

### *Molding unit*

The molding unit of this machine is essentially the same as that of the continuously rotating type of machine. The unit consists of the same essential parts, a support assembly, a pattern carrier which includes the U-shaped frame **326**, and a container for the molding material. These parts are shown in plan in Fig. 24 and in elevation in Fig. 25. Only the frame **326** of the pattern carrier is indexed around by the turntable, the remaining parts of this molding unit having a fixed location adjacent the turntable.

The support assembly includes suitable vertically extending members which mount a pivot shaft **332**, and means for rotating the pivot shaft which again consists of a gear segment **333** and a rack **334**. These vertical members consist of a shaft and rack supporting frame **335** at the left-hand side of the molding unit as the parts are viewed in Fig. 24, and a bearing support **336** at the right-hand side thereof. The support **335** carries bearings **337** and **338** for the pivot shaft together with a vertically extending structure **339** which forms a slide for the rack bar **334**.

The container unit **340** is identical in construction to the units employed in the other machine described herein. It is rotatably mounted upon the pivot shaft **332** by a pair of brackets **341**. The container normally occupies an upright position with a lower corner of its storage section **342** resting upon a supporting block **343** and its opening **344** being directed generally upwardly.

The pattern carrier is of split construction. In addition to the U-shaped frame member **326** which directly engages the pattern assembly, it comprises three members, a pair of stub arms **345** and a shifting arm **346**, each attached to the pivot shaft for rotation therewith. A jaw **347** is formed on the outer or free end of each arm **345** and the pair of stub arms are spaced on the pivot shaft **332** so that these jaws **347** are each in alignment with a tongue **348** provided at the ends of the U-shaped carrier frame **326**.

The third additional member of the pattern carrier, the shifting arm **346**, is secured to the pivot shaft substantially midway between the pair of stub arms **345**. This shifting arm extends downwardly and then horizontally below the knockout plate of the pattern assembly and is formed with a forked end **321**. A shifting lever **349** is pivotally mounted within the forked end **321** and a shifting block assembly **350** is secured to the upper end of the lever. A guide link **351** is also secured between the forked end **321** of the shifting arm and the shifting block **350**. This block is also provided with an open jaw **322**, which is adapted to register with a tongue **352** carried on the base portion of the U-shaped carrier frame **326**. The tongue **352** includes a downwardly projecting lug **353** which is engaged by a bracket **354** carried by the shifter block **350**.

A roller **355** is secured to the downwardly extending free end of the shifter lever **349**, and with the parts in the position shown this roller **355** is contacted by one end of a crank **356**, pivotally secured to a bracket **357**

and having its other end in contact with a cam 358 carried by the drive shaft 313.

A guide rod 359 is pivotally secured to the shifter lever 349 and slidably extends through a depending bracket 360 carried by the arm 346. A spring 361 is mounted around the guide rod 359 between the lever 349 and bracket 360, and, with the parts in the position shown this spring is in compression.

*Ejector station*

The ejector station in this machine is basically similar to that previously employed. As shown in Fig. 26 and Fig. 24 the ejector consists of a horizontal table 362, carrying rollers 363 adapted to contact the knockout plate 364 of a pattern plate assembly, this table being mounted upon parallel linkages for vertical movement. The parallel linkages include an actuating link 365 having an arm 366 and cam roller 367 which contact an actuating cam 368 keyed to the main drive shaft 313.

*Drive and operation*

The motive source for this machine is mounted upon a pedestal 370 located adjacent the molding station, and consists of a reducer 371 having a motor 372 mounted on its upper surface. The output shaft 373 of the motor and input shaft 374 of the reducer appear in Fig. 24. The output shaft 375 of the reducer is located at right angles to the input shaft. A large wheel 376 carrying a cam track 377, shown in outline in Fig. 27, is secured to the output shaft 375 of the reducer as is a sprocket 378. The sprocket 378 is connected by a chain 379 to a sprocket 380 mounted on one end of the drive shaft 313. The cam track 377 of the cam wheel 376 is engaged by a roller follower 381 secured to the rack bar 334. Thus, rotation of the output shaft 375 of the reducer 371 results in a simultaneous synchronous movement of the cam wheel 376 and the drive shaft 313, rotation of the cam wheel producing movement of the parts of the molding unit through the molding cycle, while rotation of the drive shaft actuates the turntable, the ejector and the shifting mechanism for transferring the pattern plate 325 from the supporting arms 310 and 311 of the turntable to the pattern carrier of the molding unit. The arm 319 of the indexing drive and the cam wheel 376 rotate at the same speed, the indexing mechanism accomplishing its 90° movement of the turntable during 90° of one revolution, leaving the remainder for the molding and ejecting operations.

Fig. 27 shows the position of the cam wheel 376 at the end of the indexing movement of the turntable, the roller follower 381 of the rack 334 being in the position shown. The molding cycle of the machine is about to begin with the transfer of the pattern assembly and its U-shaped carrier frame 326 from the supporting arms 310 and 311 of the turntable to the carrier parts of the molding unit.

This operation is controlled by the cam 358, which permits the crank 356 to move in a counterclockwise direction from the position shown in the plan view of Fig. 24. This movement in turn allows the spring 361 to produce a counterclockwise movement of the shifting lever 349 as the parts are shown in Fig. 25. Counterclockwise movement of the shifting lever 349 causes horizontal movement of the shifting block 350, bringing its jaw 322 into engagement with the tongue 352 on the U-shaped frame 326. Further movement of the shifting lever 349 produces sliding movement between the lugs 328 of the U-shaped frame 326 and the brackets 329 secured to the arms 310 and 311. Before the lugs 328 have slid beyond the outer ends of the brackets 329, the tongues 348 on the ends of the U-shaped frame come into engagement with the jaws 347 of the pattern carrier arms 345, and further lateral movement of the frame is accompanied by a slight upward movement of its outer ends as the tapered tongues 348 seat in the tapered jaws 347. When movement of the shifter lever ceases, the U-shaped frame 326 is secured at three points to the other parts of the pattern carrier and at the same time has been moved laterally a sufficient amount that its lugs 328 are clear of engagement with the brackets 329 in both horizontal and vertical directions.

After the carrier frame has been gripped in the carrier arms the cam roller 381 is forced downwardly, moving the rack bar downwardly and producing a counterclockwise rotation of the shaft 332, with corresponding motion of the pattern carrier keyed to it, and the pattern carrier is rotated counterclockwise into a position of juxtaposition with the container 340.

The latch dog 385 carried by the U-shaped frame is then engaged by the latch 386 secured to the container, this latch being identical to the toggle operated latch of the container as previously described herein.

The cam wheel 376 next causes upward motion of the rack 334, with clockwise rotation of the shaft and pattern carrier and the container latched thereto, and the parts are brought as before to a position from 20 to 30° below the horizontal so that molding material will flow out of the discharge opening of the container and evenly cover the pattern plate, allowance being made for the angle of repose of the material so that a uniform depth of covering will be obtained. A period of dwell next follows in this molding position and then the rack bar 334 is again moved downwardly to bring the pattern carrier and container back to the normal position of the latter. Actuation of the latch 386 then releases the pattern carrier from the container.

After the container has been rotated back to its normal position, cam 358 produces positive clockwise rotation of the shifter lever 349 which motion first disengages the shifter bar jaw 322 from the tongue 352 of the U-shaped frame and allows the withdrawing lug 353 of the frame to be engaged by the bracket 354 secured to the shifter bar 350. Further motion of the shifter lever in this direction positively withdraws the frame from engagement with the arms 345 and re-engages the lugs 328 of the frame with the brackets 329 of the supporting arms 310 and 311.

At the time this separating movement of the pattern carrier parts is completed the drive arm 319 has moved 270° clockwise from the position shown in Fig. 24 and is just engaging a slot 388 of the driven wheel 320, and a 90° indexing movement of the turntable ensues, placing the supporting arms and carrier frame bearing the mold just formed into the oven for curing.

The structure of the machine preferably includes a circular guard rail 390 which extends around the machine adjacent the position of the ends of the U-shaped carrier frame 326, except at the molding station. This rail 390 acts as a guard to prevent the frame from becoming disengaged from the brackets 329 of the supporting arms, and, in addition to the tongues 348 on the ends of the frame 326, the pattern assembly is provided with a bracket 391 which projects outwardly and also lies adjacent the guard rail so that the frame 326 and pattern assembly lie contiguous to the guard rail at three arcuately related points.

The next indexing movement of the turntable subjects the mold to further curing and following this second stage in the oven, the next movement brings the pattern assembly to the ejector station, where rotation of the cam 368 with the drive shaft 313 produces upward movement of the ejector table 362. Through movement of the ejector plate 364 and ejector pins 392, the mold is stripped from the pattern, the construction of the pattern assembly in this respect being identical to that previously described.

We claim:

1. Mean for depositing a coating of material on a surface, including a carrier unit adapted to support a surface to be coated, a container unit for holding a quantity of coating material, supporting means defining a pivotal axis to which said carrier and container are each connected, and means for rotating at least one of said units

about said common pivotal axis into juxtaposition with the other of said units.

2. Coating means according to claim 1 further including means for interconnecting said units in juxtaposed relation, and wherein said means for rotating at least one of said units about said common pivotal axis include means for rotating said units in juxtaposed relation to a position where said container unit is superimposed over said carrier unit.

3. Coating means as set forth in claim 1 wherein said means for rotating at least one of said units about said common pivotal axis includes a cam track, means for producing relative movement between said cam track and said supporting means, and means for translating such relative movement into rotation of at least one of said units.

4. Coating means as set forth in claim 1 further characterized by said supporting means being connected to a rotatable turntable, and means for rotating at least one of said units about said common pivotal axis in response to movement of said turntable.

5. Coating means as set forth in claim 1 wherein said supporting means includes a rotatable shaft, one of said units being connected to said shaft for rotation therewith and the other of said units being pivotally mounted on said shaft, and means for rotating said shaft to bring the said unit rotating therewith into juxtaposition with the other of said units.

6. Coating means as set forth in claim 5 wherein said means for rotating said shaft includes a gear connected to said shaft, a rack slidably carried by said supporting means and engaging said gear, and means for actuating said rack.

7. Coating means as set forth in claim 1 wherein said container unit includes a discharge section having an opening adapted to be covered by the surface to be coated and a material storage section disposed laterally with respect to said opening.

8. Coating means as set forth in claim 7 further including means for oscillating said units about said pivotal axis in juxtaposed relation in which the opening of said container is covered by said surface to a position where the material in said container gravitates from the storage section thereof to said discharge section thereof, and for returning said units to a position where the material in said container gravitates back to said storage section thereof.

9. Coating means as set forth in claim 8 wherein the gravitational discharge position of said container is one where the plane defined by the borders of the opening thereof is at an angle of substantially 30° below the horizontal, and wherein the gravitational return position of said container is one where said plane is at an angle of substantially 30° beyond the vertical.

10. Coating means as set forth in claim 1 wherein said carrier unit includes a frame portion adapted to support a pattern plate assembly including the surface to be coated, said frame portion including a pair of spaced side members, an end member movable relative to at least one of said side members, said carrier unit and said container unit being provided with interengaging latch members, the latch member of said carrier unit being secured to the end member thereof for movement between an operative and an inoperative position, means for rotating one of said units about said common pivotal axis to bring said latch members into engagement, and means carried by a pattern plate assembly for defining the said operative position of said carrier latch member.

11. Coating means as set forth in claim 10 wherein the latch member of said carrier unit is freely pivoted to the end member thereof, said latch member pivoting to an inoperative position except when engaged by an adjacent surface of a pattern plate assembly supported by said carrier unit.

12. A pattern carrier unit for a shell molding machine comprising a frame portion adapted to receive a pattern plate assembly, said frame portion including a pair of side members, a pattern receiving slide, means pivotally connecting a slide to each of said side members on an axis located substantially midway of the length of the frame portion of said side members.

13. A pattern carrier unit as set forth in claim 12 further including means for adjusting the location of the pivotal axis of said slides.

14. A pattern carrier unit as set forth in claim 12 wherein the frame portion of said carrier unit further includes an outer end member, means pivotally connecting said end member to one of said side members and latch means connecting the other end of said end member to the other of said side members.

15. A pattern carrier unit for a shell molding machine comprising a frame portion adapted to receive a pattern plate assembly, said frame portion including a pair of side members, means carried by said side members for engaging a pattern plate assembly, an end member movable relative to at least one of said side members, a latch member secured to said end member for movement between an operative and an inoperative position, said pattern plate assembly being provided with means for defining the operative position of said latch member.

16. A molding unit for a shell molding machine comprising a support assembly, means carried by said support assembly defining a pivotal axis, a pattern carrier unit having a frame portion adapted to receive a pattern plate, means connecting said frame portion to said pivotal axis, a container unit adapted to hold a quantity of molding material, said container unit having an opening for the passage of molding material therefrom, means connecting said container to said pivotal axis, and means for rotating said units about said pivotal axis to bring the frame portion of said carrier unit into juxtaposition with the opening of said container unit.

17. The molding unit of claim 16 wherein the means for rotating said units about said pivotal axis includes cam means defining a sequential cycle of movement of said units in the following steps: movement of said pattern carrier from an initial position to a position wherein the frame portion thereof is superimposed over the opening of said container unit, movement of said pattern carrier and container to a position where said container is superimposed over said pattern carrier, movement of said pattern carrier and container to a position where said pattern carrier is superimposed over said container unit, and movement of said pattern carrier to said initial position thereof.

18. A molding unit according to claim 17 wherein said means for rotating said units about said pivotal axis includes means for directly moving said carrier unit and means for connecting said carrier unit in juxtaposed relation with said container unit.

19. A molding unit as set forth in claim 18 wherein said means for connecting said carrier unit in juxtaposed relation with said container unit includes a latch member carried by said frame portion of said carrier unit, said latch member being adapted to be held in operative position by a pattern plate supported by said frame portion.

20. Means for depositing a coating of material on a surface comprising a carrier unit having a frame adapted to receive the surface to be coated, a container unit for holding a quantity of coating material, said container unit including an opening adapted to be covered by the surface to be coated, supporting means to which said carrier unit and said container unit are connected for movement about a common pivotal axis, means normally positioning said container unit with the opening thereof facing generally upwardly, and means including a cam for moving said units about said common pivotal axis, said cam defining an operating cycle wherein said carrier unit is first moved about said pivotal axis into juxtaposed relationship with said container unit, said carrier unit and said container unit are then moved about said pivotal axis until said container unit is superimposed over said carrier unit, said

carrier unit and said container unit are then moved about said pivotal axis until said container unit occupies its said normal position and said carrier unit is then moved about said pivotal axis to a return position.

21. Coating means as set forth in claim 20 wherein said means for moving said units about said common pivotal axis includes means for directly moving said carrier unit, latch means for interconnecting said carrier unit and said container unit engageable upon said carrier unit reaching a position of juxtaposed relationship with said container unit, and means for releasing said latch means prior to the movement of said carrier unit to a return position.

22. Coating means as set forth in claim 20 further characterized by said supporting means being connected to a rotatable turntable, means for moving at least one of said units about said common pivotal axis in response to movement of said turntable, latch means for interconnecting said units in juxtaposition, means for actuating said latch means to engaged and released positions in response to movement of said turntable.

23. Coating means as set forth in claim 20 further characterized by said carrier unit, said container unit, and said supporting means therefor being mounted on a turntable unit for rotation about a vertical axis, said cam means for moving said units about said common pivotal axis including a stationary cam track positioned adjacent a portion of the path of travel of said units on said turntable, a cam follower, and means for translating motion of said cam follower into movement of said carrier unit about said common pivotal axis.

24. Coating means as set forth in claim 23 wherein said means for translating movement of said cam follower into movement of said carrier unit comprises a shaft carried by said supporting means and defining said common pivotal axis, means securing said carrier unit to said shaft for rotation therewith, and means for translating movement of said cam follower into rotation of said shaft.

25. Coating means as set forth in claim 20 wherein said cam means for moving said units comprises a cam track, and a cam follower carried by one of said units and adapted to contact said cam track.

26. Coating means as set forth in claim 20 wherein said means for moving said units through said cycle comprises a shaft carried by said supporting means and defining said common pivotal axis, means connecting said carrier unit to said shaft for rotation therewith, a gear carried by said shaft, a rack member slidably carried by said supporting means and engaging said gear and a cam follower carried by said rack.

27. Coating means as set forth in claim 26 further including means for defining the said return position of said carrier unit comprising means for limiting movement of said rack member, and means for rendering said movement limiting means inoperative when said units are moved to the position where said container unit is superimposed upon said carrier unit.

28. In a machine of the type described the combination of a turntable mounted for rotation about a vertical axis and a molding unit positioned on said turntable radially with respect to said vertical axis, said molding unit including a container unit, a pattern carrier unit and a support to which said container and carrier are each connected for rotation about a common pivotal axis, said carrier unit including a frame adapted to support a pattern plate assembly.

29. The machine of claim 28 further including means for rotating said turntable and actuating said molding unit in a molding cycle from a common source of motive power.

30. In a machine of the type described having a turntable mounted for rotation about a vertical axis, a molding unit including a pattern carrier and a container, supporting means carried by said turntable and defining a horizontal pivotal axis, means connecting said container to said horizontal pivotal axis, means connecting said pattern carrier to said horizontal pivotal axis, and means for moving said container and pattern carrier about said horizontal pivotal axis in a molding cycle in response to movement of said turntable.

31. A machine according to claim 30 wherein said supporting means for said pattern carrier and container includes a rotatable shaft defining said pivotal axis and wherein one of said units is connected to said shaft for rotation therewith.

32. A machine according to claim 30 wherein said supporting means for said container and pattern carrier comprises a pedestal member, a shaft rotatably supported thereby and defining said horizontal pivotal axis, a pinion carried by said shaft, a rack carried by said pedestal and engaging said pinion and means for reciprocating said rack in response to movement of said turntable.

33. A machine according to claim 32 wherein said means for reciprocating said rack comprises a stationary cam track positioned adjacent said turntable and a cam follower carried by said rack.

34. In a machine of the type described having a turntable mounted for rotation about a vertical axis, a plurality of molding units carried by said turntable, each molding unit comprising a container unit, a pattern carrier unit and a support assembly to which said container and carrier units are each connected for rotation about a common pivotal axis, means connecting each supporting means to said turntable, and cam means for rotating each of said container and pattern carrier units about their common pivotal axis in response to movement of said turntable, said last-named means defining a molding cycle comprising the following sequential steps: movement of said pattern carrier unit from an initial position to a position adjacent the normal position of said container unit, movement of said pattern carrier and container to a depositing position where said container is superimposed over said carrier, movement of said pattern carrier and container to the normal position of the latter and movement of said pattern carrier to said initial position thereof.

35. A machine as set forth in claim 34 wherein said means for rotating said units about said pivotal axis includes means for directly moving a carrier unit and means for connecting such carrier unit to the container unit associated therewith.

36. A machine as set forth in claim 35 wherein said means for connecting said carrier unit to said container unit comprises a latch assembly carried by one of said units and means for actuating said latch assembly in response to movement of said turntable.

37. A machine as set forth in claim 34 wherein the degree of movement of said carrier unit from its normal position to the normal position of said container unit is less than the degree of movement of said pattern carrier and container from the normal position of the latter to said depositing position.

38. A machine as set forth in claim 34 wherein said container is provided with a material depositing section including an opening adapted to be covered by a pattern plate assembly carried by said pattern carrier, and a storage section disposed laterally relative to said depositing section, and said turntable includes means for supporting said container in a normal position where the storage section thereof is positioned below said depositing section and the plane of the opening of said depositing section lies at an acute angle to the vertical.

39. A shell molding machine having a turntable supported for rotation about a vertical axis and an oven unit surrounding at least a portion of the circumference of said turntable, a molding unit including a pattern carrier and a container, said pattern carrier having a frame adapted to receive a pattern plate, means pivotally connecting said container and said pattern carrier to said turntable, the frame portion of said carrier being spaced from the loca-

tion of said pivotal connection, means defining a normal position of said pattern carrier wherein the frame portion thereof is displaced radially relative to the vertical axis of said turntable from the location of said container and said pivotal connection, the position of said oven relative to the axis of rotation of said turntable corresponding to the radial location of the frame portion of said pattern carrier in said normal position thereof, and means for permitting movement of said pattern carrier through said oven upon rotation of said turntable comprising a continuous slot formed in at least one wall of said oven between the ends thereof, said slot being dimensioned to receive the adjacent portion of said pattern carrier and the slotted wall of said oven serving to separate the frame portion of said pattern carrier from the remaining components of said molding unit during the passage of said pattern carrier through said oven.

40. A machine as set forth in claim 39 further including baffle means carried by said turntable and adapted to at least partially close said slot.

41. A machine as set forth in claim 39 wherein said means for defining the position of said pattern carrier includes a track extending around a portion of the circumference of said turntable and spaced radially from said pivotal connection, said track contacting said pattern carrier.

42. A machine for depositing a coating of finely divided pulverant material upon a surface including a turntable, means for rotating said turntable about a substantially vertical axis, a plurality of spaced containers carried by said turntable, each container including an aperture normally facing upwardly, means for supplying said pulverant material to said containers comprising a hopper, means supporting said hopper above said turntable and with the discharge opening thereof positioned above the path of travel of said container openings, the discharge portion of said hopper being mounted for movement to a discharge position wherein the mouth of said hopper is disposed in alignment with the opening in said container, and means for moving said discharge portion of said hopper to discharge position in synchronism with the movement of one of said containers to a position in alignment therewith.

43. A machine of the type described including a turntable, means for intermittently rotating said turntable about a vertical axis, a frame adapted to receive a pattern plate, means detachably supporting said frame upon said turntable, a molding unit positioned adjacent the circumference of said turntable and including a pattern carrier, said pattern carrier having means engageable with said frame, and means for moving said frame radially of said turntable into engagement with said pattern carrier.

44. A machine of the type described including a turntable, a frame adapted to receive a pattern plate, frame supporting means carried by said turntable, means slidably connecting said frame to said supporting means for movement of said frame radially relative to the center of said turntable, means for intermittently advancing said turntable and supporting means into registry with a molding station, said molding station comprising a molding unit including a pattern carrier, said pattern carrier having means for engaging said frame and shifting means for producing relative movement between said frame and said supporting means to a position of disengagement of said frame therefrom.

45. A machine as set forth in claim 44 wherein said pattern carrier comprises a frame engaging member and a shifter arm, said shifter arm carrying means for initially engaging said frame for sliding movement on said supporting means into engagement with said engaging member.

46. A machine as set forth in claim 45 further including a rotatable shaft carried by said molding unit, a container pivotally secured to said shaft, and wherein said frame engaging member and shifter arm of said pattern carrier are secured to said shaft for rotation therewith.

47. A machine as set forth in claim 46 wherein said container and pattern carrier normally occupy radial angularly spaced positions with reference to the center of said shaft, means to oscillate said shaft to move said pattern carrier into a position adjacent said container to superimpose said container over said pattern carrier, and to return said container and pattern carrier to their initial positions.

48. A machine as set forth in claim 47 further including means for intermittently rotating said turntable operating in synchronism with said means for oscillating said shaft, said turntable rotating means producing movement of said turntable in sequence with the oscillating cycle of said shaft.

49. A machine as set forth in claim 48 further including means for operating said pattern carrier shifter arm during an interval intermediate the sequential rotation of said turntable and oscillation of said shaft.

50. A machine as set forth in claim 44 further including means positioned adjacent the circumference of said turntable for limiting relative movement between said frame and said supporting means at positions of said supporting means other than at said molding station.

51. A machine of the type described comprising a molding unit including a container, a pattern carrier and supporting means to which said container and pattern carrier are connected for movement about a common pivotal axis, said pattern carrier including a frame portion adapted to receive a pattern plate, means detachably securing said frame portion to said pivotal axis, a turntable positioned adjacent said molding unit, a pair of supporting arms carried by said turntable, means for connecting said frame portion in detachable engagement with said supporting arms, and means for moving said pattern carrier relative to said supporting arms.

52. A machine of the type described including a turntable, a frame adapted to receive a pattern plate, frame supporting means carried by said turntable, means detachably connecting said frame to said supporting means, means for intermittently advancing said turntable and supporting means into registry with a molding station, a curing station and an ejecting station, said molding station including a container, a pattern carrier and means for transferring said frame from said supporting means to said pattern carrier for movement in a mold forming cycle, said ejector station including a knockout member movable relative to said supporting means in an ejecting cycle, a cam type driving member for said turntable, said molding cycle, said transfer means and said ejector cycle, and means for motivating each of said cam type driving members in synchronism from a single source of motive power.

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