

[54] **SHORT-CYCLE MOLDING DEVICE**

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[51] Int. Cl. **B29c 5/00**

[58] Field of Search 425/246, 247, 253, 248,
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164/326, 327, 328; 264/297, 299

[56]

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[57]

ABSTRACT

A short-cycle molding device for a quick-setting fluid substance such as polyurethane, which includes a carousel rotating with uniform motion and a frame oscillating around the carousel pivot and on which at least one pouring head is mounted. The pouring head is mounted in such a manner that it accompanies the carousel on a path limited during the pour and then returns to its starting point. The carousel during its forward movement drives the moving frame by catch means which is connected to the moving frame and to the carousel, and means are provided to allow the moving frame to be pushed back to its starting point.

10 Claims, 12 Drawing Figures

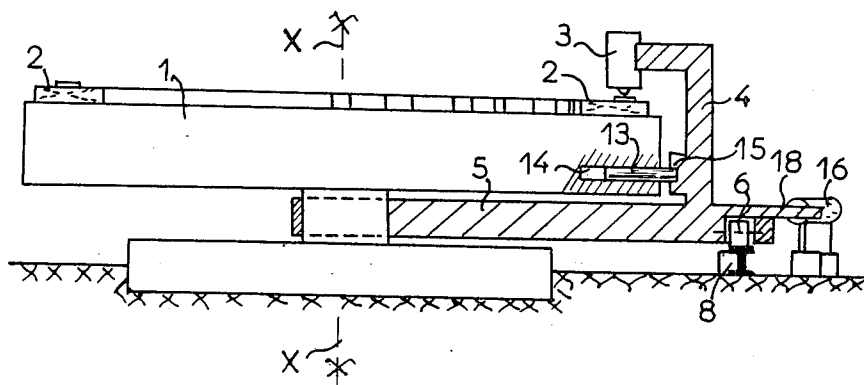


FIG.1

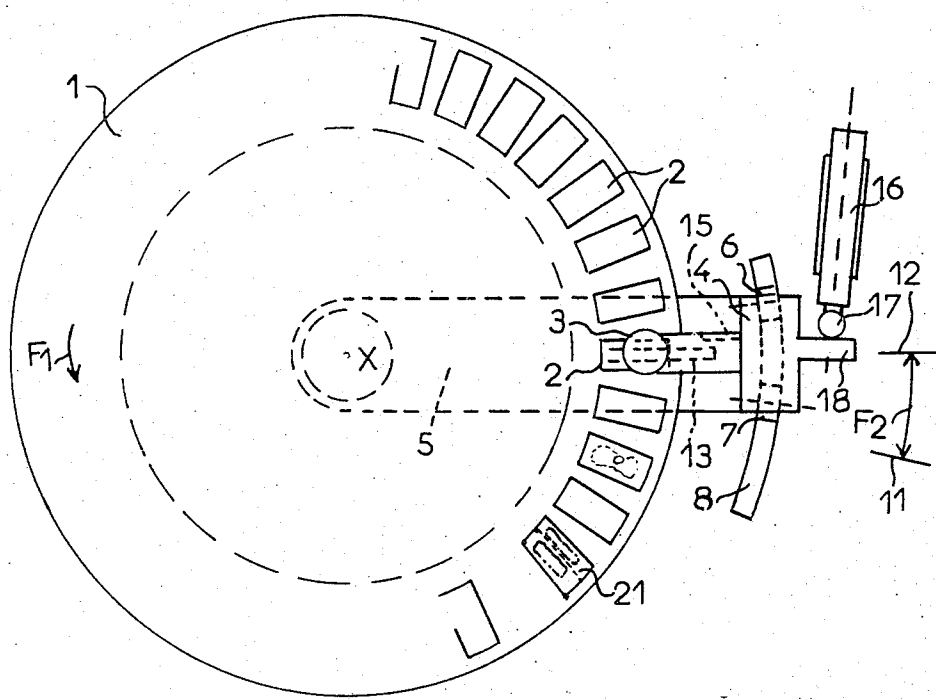
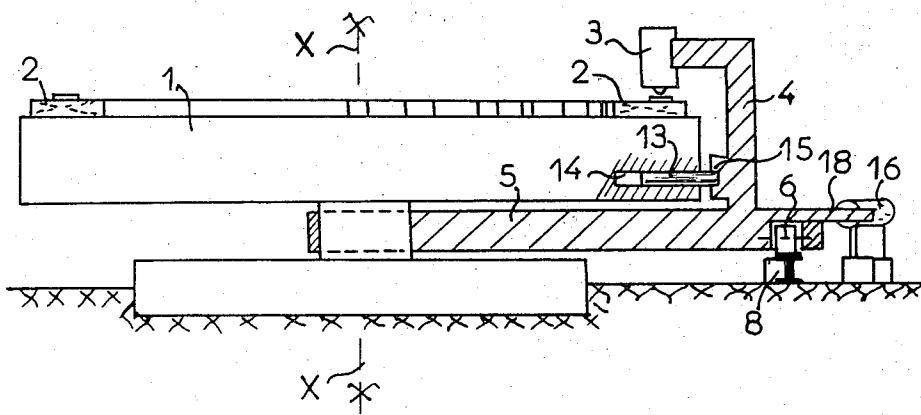


FIG.2



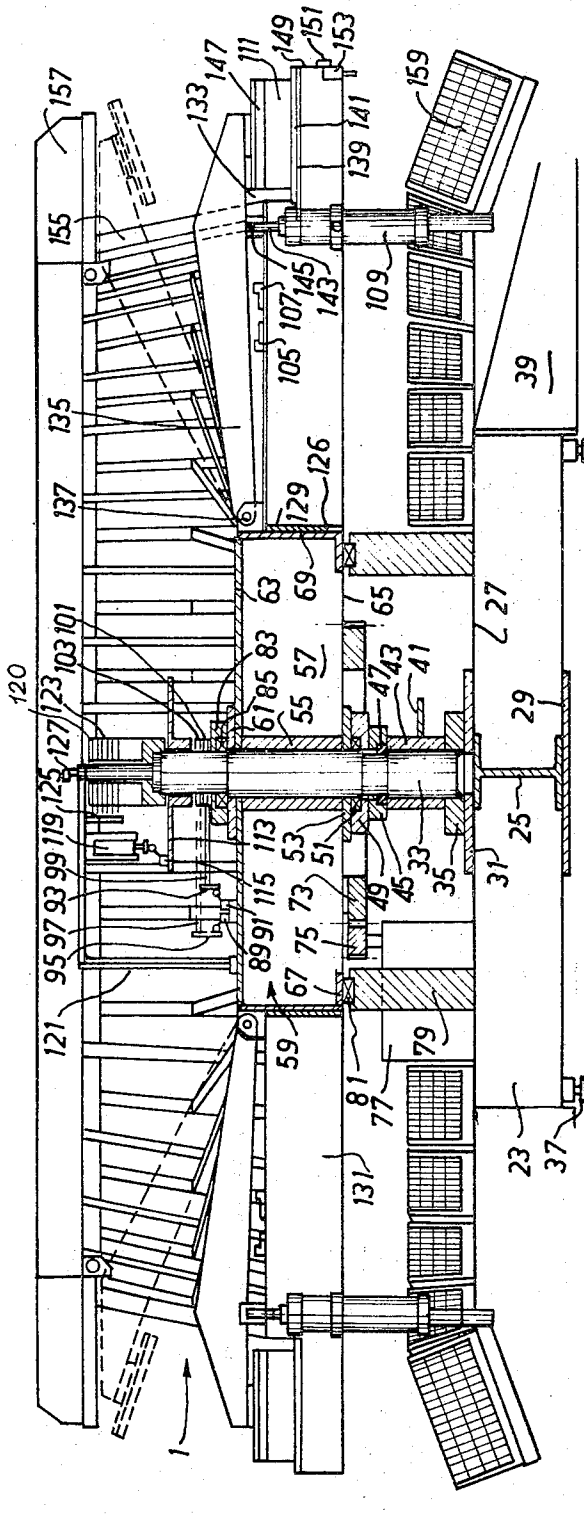
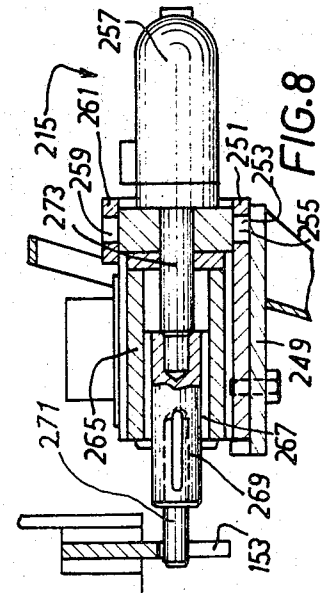


FIG. 3



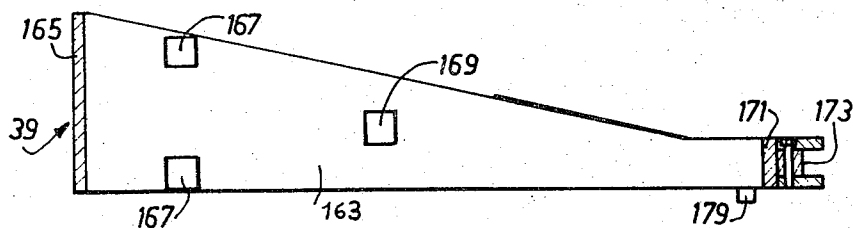


FIG. 4'

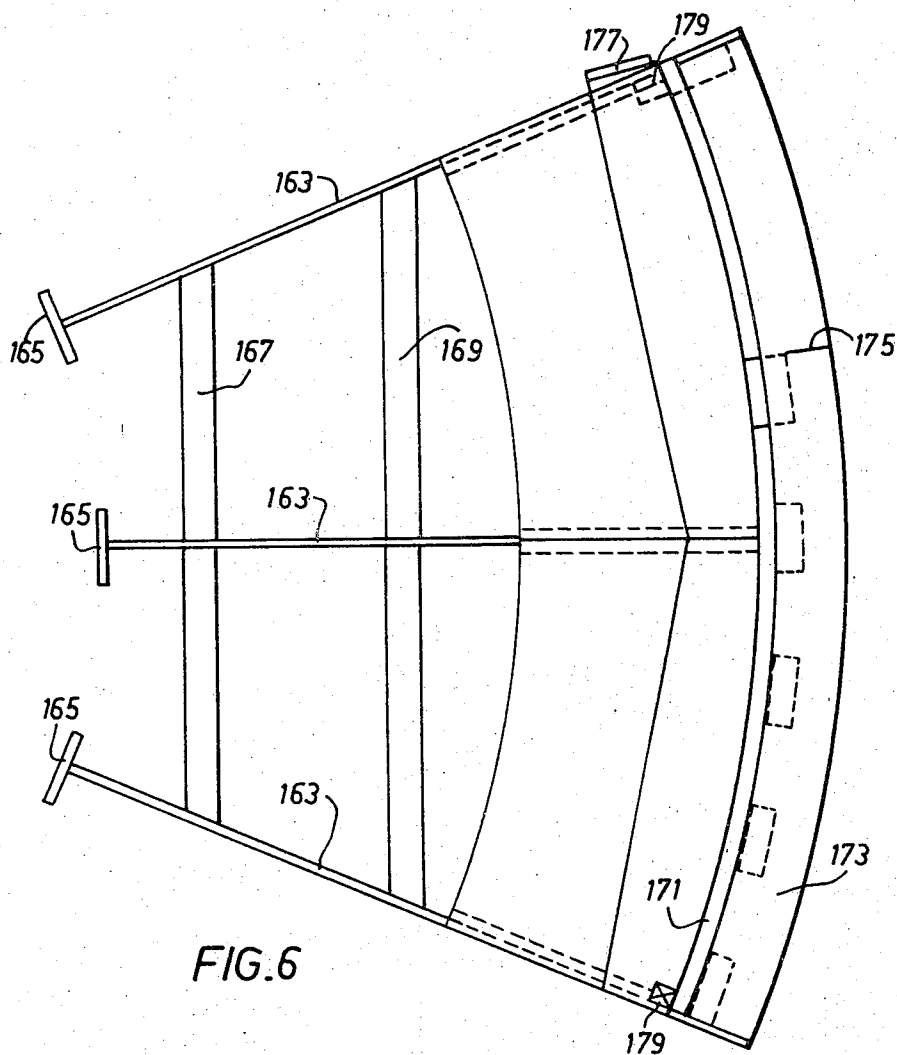


FIG. 6

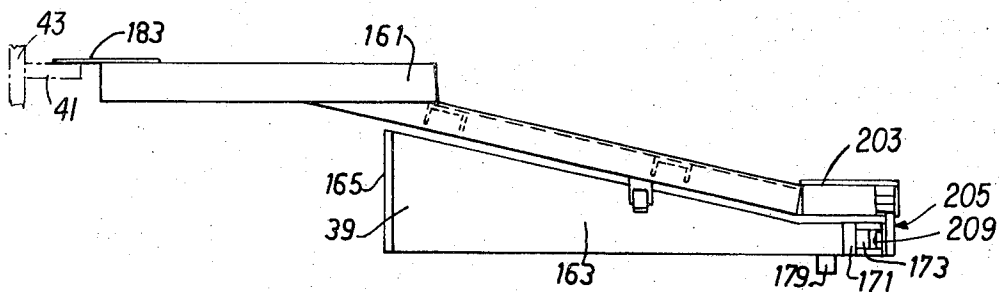


FIG. 4

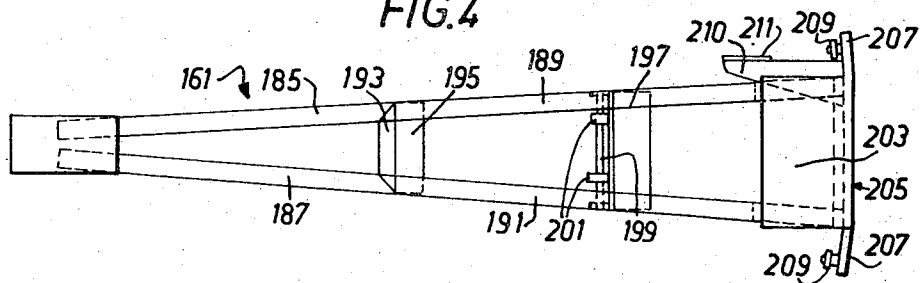


FIG. 5

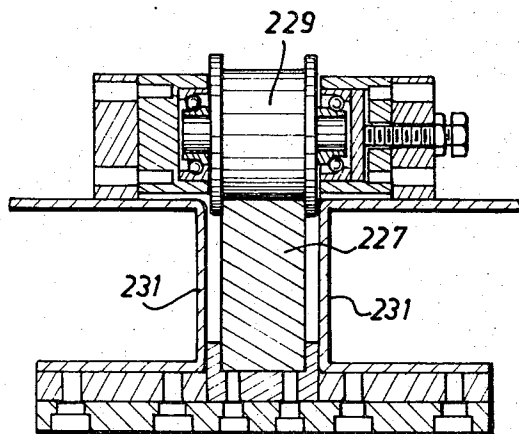
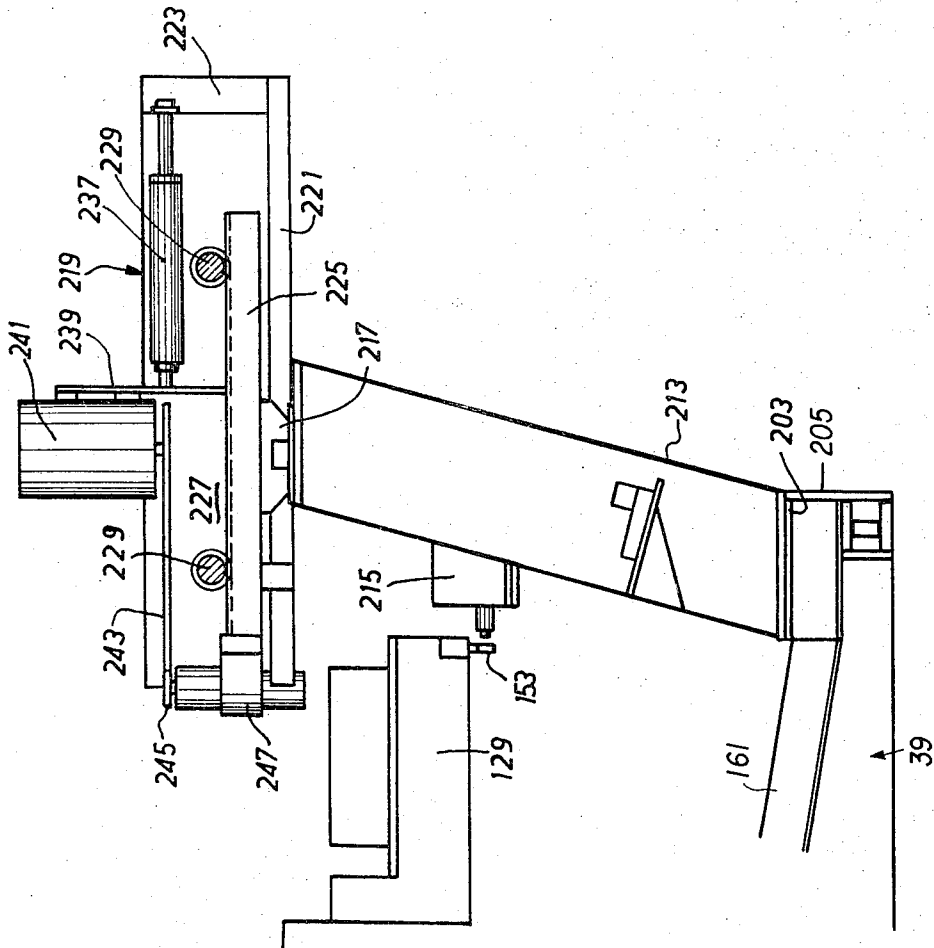
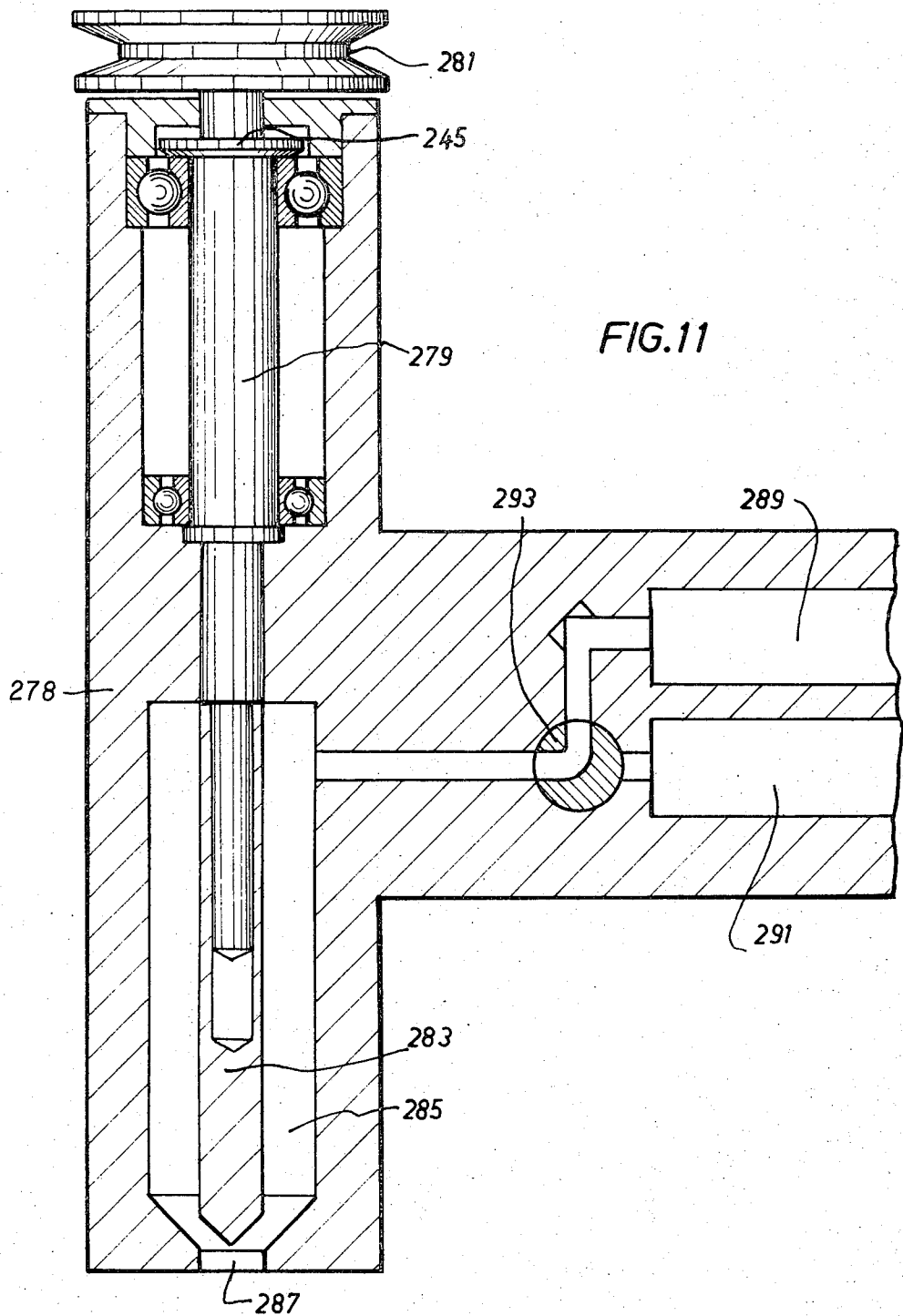


FIG. 10





SHORT-CYCLE MOLDING DEVICE

The invention relates to a short-cycle molding apparatus for a quick-setting fluid substance such as polyurethane or some other substance possessing similar characteristics, especially for the manufacture of soles for footwear.

Generally, the molding of fluid substances such as polyurethane at rapid-repetition cycles is a very delicate operation because of the quick setting of such materials in a matter of a few seconds.

It is well to remember that the molding of material of the polyurethane type is effected by pouring the mixture forming that substance into molds, and not by injection as is the case with a polyester or polyvinyl chloride (PVC).

For mass-production polyurethane molding, apparatus of the carousel type is known having a plurality of molds advancing step by step to bring each mold in succession under a stationary pouring head. This arrangement, bearing in mind the resistance of the carousel in weight and inertia, entails a dissipation of energy on each of the numerous starts and stoppages, requires working parts of considerable size and allows only a slow running speed in order to obviate impacts and even breakages.

Further, firstly, because of the rapid setting of the ingredients of polyurethane and, secondly, the considerable time between two successive pourings, due to the slowness of travel of the carousel, fouling of the pouring head frequently occurs. Such fouling requires usually cleaning the pouring head on each complete turn of the carousel.

For these various reasons, such devices lend themselves poorly to short-cycle moldings.

The apparatus of the invention eliminates those drawbacks; it allows a high-speed molding cycle, eliminates the risks of fouling the pouring head and does not, therefore, require any cleansing of the said pouring head which might interrupt the steady run of the molding device while in operation.

Consequently, the molding device according to the invention comprises a carousel revolving uniformly in motion, an arrangement swinging around the pivot of the said carousel which comprises at least one pouring head, and possibly means for spraying of a stripping agent into the molds, in such manner that the pouring head and/or the said means accompanies the said carousel on a restricted course during the pour and then returns to its starting point, the said carousel during the forward run driving the moving arrangement through a dog projecting radially and engaging a stop on the moving arrangement, and means allowing the moving arrangement to be pushed back to its starting point.

One embodiment of the invention will now be described hereunder by way of non-limitative example, with reference to the annexed drawings wherein:

FIG. 1 is a general diagrammatic plan view of a molding device.

FIG. 2 is a general diagrammatic elevation view, partly in axial section, of the device of FIG. 1;

FIG. 3 is an axial section of a footwear sole molding device for mass production;

FIGS. 4 and 4' illustrate the arm with the knock-out or clearance base associated therewith seen in longitudinal section;

FIGS. 5 and 6 respectively illustrate the arm and the clearance base of the arm in elevation.

FIG. 7 is an axial section of the base of the head and of the pouring head with a partial illustration of the clearance base of the arm, the arm and a sector carrying a mold;

FIGS. 8 and 9 are two axial sections, horizontal and vertical, of the dog-operating device;

FIG. 10 is a partial cross section of the pouring head carriage; and

FIG. 11 is an axial section of the pouring head.

Referring to FIGS. 1 and 2, a carousel 1 rotates in a manner known per se around a vertical pivot axis XX and carries a plurality of molds 2 which become filled on traveling beneath a pouring head 3. Hitherto this was achieved by step-by-step rotations of carousel 1, by placing each of the molds 2 in sequence beneath the (stationary) head 3. In accordance with the invention, carousel 1 rotates in a continuous motion, at a uniform speed, in the direction of the arrow F1 (FIG. 1) and the pouring head 3 is fitted on a moving frame 4; this moving frame 4 swings around the pivot axis XX of carousel 1 by means of an arm 5 rotating on the said pivot and by a pair of friction rollers 6 and 7 rolling on a circular portion of rail 8; the swing of the moving frame 4 is an alternating reciprocating motion between two end positions 11 and 12, as indicated by the two-way arrow F2 (FIG. 1). During the forward run of this alternating motion, namely from position 11 to position 12, the carousel 1 drives the frame 4 with the head 3 which fills the mold 2 placed beneath it; this drive can be obtained, for example as illustrated, through a dog 13, radially movable in a seating 14 of carousel 1 and engaging, when projecting, a stop 15 on frame 4, or conversely: a dog radially mobile in a seating of frame 4 engaging, when projecting, a stop or dog on carousel 1; on arrival at position 12, filling of the mold is completed, and dog 13 retracts; a jack 16 acts via its head 17 to push a stop 18 on frame 4, back to position 11 and a new cycle starts again.

The invention allows also the use of duplex molds 21; naturally the carousel in accordance with the invention can comprise two, or more, heads 3, each with its frame 4 and pertinent parts.

The following disclosure is particularly directed to a device facilitating mass-production molding of footwear soles, reaching an output of 600 pairs of soles per hour. Every component there of has been specially devised for attaining such output, bearing in mind the aforesaid difficulties in the molding of polyurethane or substances having the same characteristics.

As FIG. 3 illustrates, carousel 1 comprises in the first place a bedplate 23 composed of a spider assembly of IPN sections 25 covered by four sheet metal quadrants 27, the assembly being welded to two rims 29 and 31.

This bedplate 23 carries at its center a tubular multistep-bored bearing shaft 33, welded to the upper rim 31 and held by a carrying sleeve 35 screwed to the said upper rim. The said bedplate 23 comprises an assembly of adjustable couplings 37 guaranteeing the perpendicularity of the pivot of carousel 1, and means allowing attachment on one portion of its periphery of the arm mounting base 39. Coaxially pivotable on the bearing shaft 33 is, first of all joining tube 43 of the arm of the moving frame 4, having welded to it the arm anchor plate 41. Above the joining tube 43 and coaxially with

the bearing shaft 33, are mounted in succession a seat ring 45 of a ball thrust 47, a seat ring 49 of the lower race 51 and then the ring 53 of a shouldered tube 55. These rings 45, 49 and 53 have nut and bolt fixing means. Stiffeners 57 for a table portion 59 of the car-
 5 rousel table are welded to the shouldered tube 55. Said table portion 59 comprises two rings 53 and 61 of the shouldered tube 55 and a top face 63 attached to the top ring 61 and formed of a thick washer onto which the stiffeners 57 are welded. These stiffeners 57 are
 10 rectangular and arranged spiderwise at the rate of one every 20 degrees of arc. The bottom surface 65, of said table portion is held in position by a ring 67. The lateral edge of the table portion 59 is constituted by an assembly of rolled sheets 69 forming a cylinder. The bottom
 15 surface of the table portion 59 comprises anchoring means for a toothed ring 73 which is in mesh with a pinion 75 with torque limiter means of a variable speed reducer motor 77 mounted on one of the quadrants of
 20 bedplate 23, to drive table 59 in rotation around the bearing shaft 33.

To perfect the stability of table portion 59, a vertical stay 79 is attached to each member 25 of bedplate 23 and is fitted with ball-bearing members 81 acting on the rim 67 attached to the bottom face 65 of table portion
 25 59. A ring 83 acting as a seat for the top ball race 85 is screwed to the top shoulder 61 of shaft 33.

A ring serving to carry end-of-run switches 89 and 91 is attached to the plate 63 at the periphery of table 59. These end-of-run switches are operated by two stops 93
 30 and 95 attached respectively to two distributor stems 97 and 99 firmly mounted on the bearing shaft 33 by two seat rings 101 and 103. Said end-of-run switches 89 and 91 control the electrically actuated valves associated with the double-acting jacks 109 for effecting the
 35 opening and closure of the molds 111.

Above the two seat rings 101 and 103 is a circular plate 113 carrying end-of-run switches 115, for actuating a pour timing mechanism (not shown), said plate
 40 113 being firmly and coaxially mounted on the bearing shaft 33 by means of a cylindrical sleeve. These end-of-run switches 115 are started by a stop attached to the end of a pneumatic or hydraulic double-acting jack 119. Said jack 119 is integral with an arm 121 attached
 45 to table 59 and pivotably mounted on the bearing shaft 33. As will later be expalined, jack 119 serves to eliminate the risks of stoppage or intermittent starting of the pour timing, which would occur if a fixed stop were used. At the top of the bearing shaft 33 and coaxially
 50 mounted thereon are a stack of copper seat rings 120 and bakelite rings 123. This stacking of copper seat rings 120 and bakelite seat rings 123 forms a distributing device or feeder, associated with brushes 125 integral with arm 121 for the supply circuits of the electrical
 55 units arranged in the movable portions of the carrousel. The top of the bearing shaft also carries a rotating joint 127, associated with a hydraulic or pneumatic circuit for general supply of the jacks located in the moving portion of the carrousel.

The electric, hydraulic or pneumatic circuits are not illustrated in the drawings for reasons of simplicity. Secured to the cylindrical edge 69 are circular sectors
 60 129 arranged around table portion 59.

These sectors are composed of upright stiffeners 131 arranged radially and attached around the table portion
 65 59 by means of the cylindrical sheet 126 which is attached to the cylindrical edge sheet 69. These stiffeners

131 (7 stiffeners per sector) are rectangular in shape and have a rectangular slot 133 carrying, on the one
 hand a, first protective plate supporting valves 105 and 107 controlling jacks 109 for operating arms 135 of the
 5 mold covers pivotally connected at 137 to a circular support integral with sectors 129, and on the other hand, a second protective plate 139 furnished with a reinforcement 141 provided with screw-tappings for
 10 attachment of various molds; (either a pair of molds or a single mold). The mechanical connection between the jacks 109 and arms 135 is effected by means of a rod 143 connected to a coupling 145 on arm 135 which
 15 allows adjustment according to the height of the cover of mold 111.

The attachment of mold cover 147 to the end of the arm 135 is effected by a set-screw assembly which al-
 20 lows angular adjustment of the mold cover 147. The lateral edge of the sectors 129 is formed by a rolled sheet of stainless metal 149 to which are attached switches 151 for manual control of actuation of the
 25 arms 135 and upright stationary dogs 153 for driving the movable frame 4, arranged beneath each mold 111.

For vertical guiding of the arms 135, uprights 155 formed of rectangular tubing are attached to the stiff-
 30 eners 131. These uprights are connected together by folded sheet metal components conforming to the circumference of the assembly of sectors 129.

These sheet metal components have transverse scal-
 35 lops connected to steel guide components to allow the passage and guiding of the arms 135. Above these uprights is secured a compartment assembly 157 having as many compartments as there are molds, the purpose of which is to receive the insole and arch packings used
 40 in the manufacture of soles.

Adjoining the stiffeners and located beneath the sectors 129 are further small boxes 159 to receive the soles immediately after they have been molded.

FIGS. 4, 4', 5 and 6 illustrate respectively arm 161 of
 45 the movable frame 4 with the arm mounting base 39, in axial section, arm 161 in top plan and finally the arm mounting base 39 in plan.

The arm mounting base 39 is formed of three metal
 50 sheets 163 cut to appreciably triangular configuration, attached in radial extension of bedplate 23 by means of anchoring plates 165. This metal sheet assembly is stiffened by square section tubes 167 and 169. Secured at the front of these sheets is a curved portion 171 of a flat
 55 plate and detachable anchoring components for a rail section 173. This rail section 173 and the curved portion is restricted to the location 175, to allow passage of the thrust rod of the hydraulic or pneumatic jack for
 60 actuating the arm 161. Said hydraulic or pneumatic jack (not shown) is pivotably mounted on sheet 163 by means of the coupling support 177. The arm mounting base 39 rests on the ground, by means of two screw
 65 jacks 179 to perfect the horizontal adjustment of base assembly 39 and bedplate 23.

End-of-run switches (not shown) effecting control of
 70 the grappling dog of the movable frame (shown in FIGS. 8 and 9) are attached to the square tube 169. Square tube 167 carries the electrically actuated valve allowing actuation of the thrust jack (not shown) of the
 75 movable frame 4.

The arm 161 is attached to the anchor plate 41 on the
 80 rotatable tube 43 by an anchor guard plate 183 connected to two arm foreparts 185 and 187 arranged in

V shape, their spacing being ensured by stiffeners 193.

Onto these two arm foreparts, two arm rear portions 189 and 191 are attached, extending obliquely toward the bottom and kept rigid by stiffeners 195, 197. Disposed parallel to stiffener 197 and attached jointly to the two arm rear portions 189, 191 is a pivot shaft 199 to which are connected two adjustable stops 201 controlling the end-of-run switches (not shown) of the arm mounting base 39.

The two ends of the two arm rear portions 189, 191 carry a head anchor plate 203 and hold a head guard plate 205. This guard plate 205 is extended on both sides by two portions 207 carrying rotating pivots and rollers 209. The assembly is so provided that the rollers 209 can roll freely within the rail 173.

The arm rear portion 191 further comprises a thrust plate 210 at the head anchor plate 203 and provided with a plate bearer 211.

A second arm is also provided connected to arm 161 to carry a working part for spraying of a stripping agent into molds 111 when the head anchoring plate is not sufficient to carry both the pouring head and the said part for spraying of a stripping agent into the molds.

The bottom of the head (see FIG. 7) is formed by a metal sheet 213 bent to rectangular section and attached to anchor plate 203 of the head.

Said bottom of the head comprises the driving dog of the moving frame 4 as well as its actuating assembly 215 also shown in FIGS. 8 and 9. Said dog, in its forward position acts on the stops 153 integral with sectors 129 of carrousel 1.

The head 219 comprises a horizontal plane bearing surface 221, attached to the rotating means 217 of the base and provided with an upright rim 223.

The plane surface 221 carries an inverted T rail 225, on which a carriage 227 travels by means of rollers 229. Said carriage is formed by the assembly of two rectangular tubes 231 (FIG. 10). These two tubes 231 are provided at one of their respective ends with anchor plates (not shown) for the pouring head.

This carriage 227 is set in motion by a double-action pneumatic jack 237 attached on the one hand to the vertical rim 223 of the supporting plane surface 221 and on the other hand to an upright 239 attached to the two rectangular tubes 231 carrying the motor 241. Said motor 241 drives the pouring head turbine 247 through a belt 243 and a revolving circuit 245.

The assembly of the dog and its actuating device 215 shown in FIGS. 8 and 9 is formed by the base 249 attached onto the bottom of the head having a bedplate 251 screwed thereto and comprising a recess of the cover 253 for the pin 255 of the stay acting as a support for the dog-actuating jack 257, the corresponding pin 259 being housed in a recess of the cover 261, bedplate 251 and cover 261 being fixed by cheeks 263.

This stay also carries the body 265 of dog 271 provided with a bedplate 267 wherein the shaft 269 slides and wherein the dog 271 is mounted. Said dog 271 is actuated by rod 273 of jack 257. The dog assembly 271 of the body 265 and actuating jack 257 rotates horizontally around the pins 255 and 259 following a course limited by a stop 275 and an end-of-run switch 277 controlling jack 119 (FIG. 3). It is well to note that dog 271 can have a multitude of shapes, particularly to allow good engagement with the vertical dogs 153 driving the movable frame 4.

FIG. 11 is an axial section of a pouring head which can be used for the pouring of polyurethane type substances.

This pouring head comprises a body 278 in which a shaft 279 is pivotably mounted carrying at its top end a roller assembly 245 comprising a pulley 281 and at its lower end a spiral-gear decreasing-pitch turbine 283 housed in a mixing chamber 285 of body 278. In line with said turbine 283 and the body 278 is a tap hole 287. On the lateral portion of the body, two feed pipes 289 are fixed and the two return pipes 291 for the same materials. The two feedpipes 289 and the two return pipes 291 for the working materials are controlled by a cylindrical valve 293 which, according to the position it is in directs the substances either toward the mixing chamber 285 or toward the return circuits 291. Said valve 293 is controlled by a device (not shown) comprising a double-acting pneumatic or hydraulic jack connected to a gearing assembly. The working of this pouring head is such that for a suitable position of the valve 293, the two constituent substances of polyurethane, coming from the two feed circuits 289 flow into the mixing chamber 285, are projected downward by the turbine 283 mixing together as they do so. Such projection of these substances is reduced proportionately to the descent of the materials by reason of the decrease of the turbine pitch 283. At the bottom of the turbine, the pitch is zero and the mixture flows into the tap hole 287.

The operation of this device for one pouring sequence from a mold is as follows:

After the preceding pour, the moving frame 4 returns to the rearward position, the grappling dog 271 controlled by the end-of-run switches mounted on the square tube 168 is then in the advanced position and contacts the vertical dog 153. This engagement brings on the rotation of the whole assembly of the dog 271, body 265 and jack 257 causing the operation of the end-of-run switch 277. This end-of-run switch controls the action of the jack 119 which, through its stop triggers an end-of-run switch 115 which at that moment stands in line with the said jack 119. This latter end-of-run switch starts the pour timing mechanism and therefore the start of pouring. The moving frame is then set rotating through the action of dog 153 on dog 271. The pour takes place in two stages: a first stage during which the carriage 227 remaining motionless, the heel is poured, and a second consecutive stage at the end of the heel pour, in the course of which the carriage moves in reciprocating motion to allow a good distribution of the flow on the arch and skid of the sole. At the same time as this pouring, the spraying of a stripping agent into a second mold takes place after stripping off the sole.

The moving frame continues to revolve until its stop 201 comes in contact with the end-of-run switch to which it is assigned, controlling the thrust jack of the arm 161, and until the end-of-run switch fitted on the square tube 168 operates the withdrawal of the dog 271.

At that moment, the pour and cleansing being completed and the carriage 227 having returned rearward, the thrust jack of the arm pushes the moving frame 4 back to its rear station. The sequence is then completed for that particular mold and the procedure begins again for the next mold.

At the instant following the end of the pour and after return of the moving frame 4 to its rear position, and through the operation of a stop 95 on the end-of-run switches 89 on the electrically actuated valve 105, the corresponding jack 109 guarantees closure of the mold.

After a length of time equivalent to the setting of the polyurethane, and under the action of the stop 93 on the end-of-run switch 91 on the electrical valve 107, the corresponding jack effects opening of mold 111, allowing the sole to be stripped out.

It is well to note that the molding device in accordance with the invention can comprise a carrousel of different shape and constitution, for example, a carrousel whose moving part is composed of a carrying chain or an escalator on which the molds are attached, the transposition of the moving frame and of the actuating devices posing no problem to one skilled in the art.

I claim:

1. Apparatus for rapid cyclic molding of a quick setting fluid material such as polyurethane, said apparatus comprising a carrousel mounted for rotation about a vertical axis, means for continuously rotating said carrousel about said vertical axis, said carrousel including a circular table and a series of molds on said table at the periphery thereof, covers for said molds, radial arms pivotably supported on said carrousel and carrying said covers, means for pivoting said arms to move said covers and open said molds during a material pouring operation and close said molds during setting of the material, and a pair of abutments corresponding to each mold and fixed at the periphery of said table; a movable assembly mounted for pivotable movement around said vertical axis below said table and including at least one pouring head extending at a level above said molds for introducing said material into the molds entrainment means for driving said movable assembly by said carrousel over a limited path of annular travel, and means for reciprocally moving the pouring head above a corresponding mold during the pouring operation, said entrainment means comprising a radial finger supported from said movable assembly for radial movement between extended and retracted positions, said finger in the extended position engaging one of said abutments to drive said movable assembly and in the retracted position being free from said abutments to permit the movable assembly to return to an initial position.

2. Apparatus as claimed in claim 1 wherein said pouring head includes two sections and each mold includes two corresponding sections.

3. Apparatus as claimed in claim 1 comprising end of travel switch means for operating said pivoting means for said arms, and actuator means for said end of travel switch means carried by said table.

4. Apparatus as claimed in claim 1 comprising a timing mechanism for controlling the pouring head and means for actuating the timing mechanism comprising a circular plate fixedly mounted around said vertical axis, a pair of switches secured to said plate and connected to the timing mechanism, and means for actuating said switches comprising a jack fixed to said table, and an abutment secured to said jack, and electrical

distribution means disposed in the carrousel for supply of electrical energy to electrically operative elements.

5. Apparatus as claimed in claim 1 comprising a stationary base supporting said carrousel, a rail section fixed on said base, said movable assembly being rollably supported on said rail and pivotable about said axis, jack means coupled to said movable assembly to return the same to said initial position after completion of the pouring operation, end of travel switch means fixed to said base, and adjustable actuator means secured to said movable assembly for activating said end of travel switch means, the latter being connected for controlling the radial movement of said radial finger and the means which reciprocally moves the pouring head.

6. Apparatus as claimed in claim 1 wherein said means for reciprocally moving said pouring head comprises a carriage radially displaceable on said movable assembly, said pouring head being secured on said carriage, and jack means for radially displacing said carriage.

7. Apparatus as claimed in claim 1 wherein said pouring head comprises a body, a pivotal shaft in said body, a roller mechanism on said shaft at one end thereof, and a turbine on said shaft at the lower end thereof, said body having a mixing chamber in which said turbine is rotatable and an outlet orifice opening into said mixing chamber, first conduit means for inflow of materials to be poured, second conduit means for return flow of said material, and valve means for selectively connecting said first conduit means to said mixing chamber or to said second conduit means.

8. Apparatus as claimed in claim 1 wherein said entrainment means further comprises a base member supporting said finger for radial displacement, a base portion fixed to said base member and provided with a recess, a cross-member including a pin engaged in said recess, a jack supported on said cross-member and operatively coupled to said finger, a cover having a recess, a further pin on said cross member engaged in the recess in said cover, side plates securing said base member and cover together and also supporting said finger, a shaft carrying said finger, a body slidably supporting said shaft, and means supporting said finger, body and jack as a pivotal assembly around said pins for limited angular adjustment and a travel limit switch means for engaging said assembly to limit travel thereof.

9. Apparatus as claimed in claim 8 wherein said travel limit switch means comprises a fixed abutment and a yieldable switch assembly, and means for actuating said switches comprising a jack fixed to said table, and an abutment secured to said jack, and electrical distribution means disposed in the carrousel for supply of electrical energy to electrically operative elements, said yieldable switch assembly being connected to said jack which is fixed to said table and carries said abutment to control the operation of said jack.

10. Apparatus as claimed in claim 8 wherein said finger has a shape to provide good engagement with said one abutment in said extended position.

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