Aug. 9, 1960 R. O. A. PETERSEN 2,948,019

METHOD FOR CASTING BUTTONS AND THE LIKE

Filed March 14, 1955

4 Sheets-Sheet 1

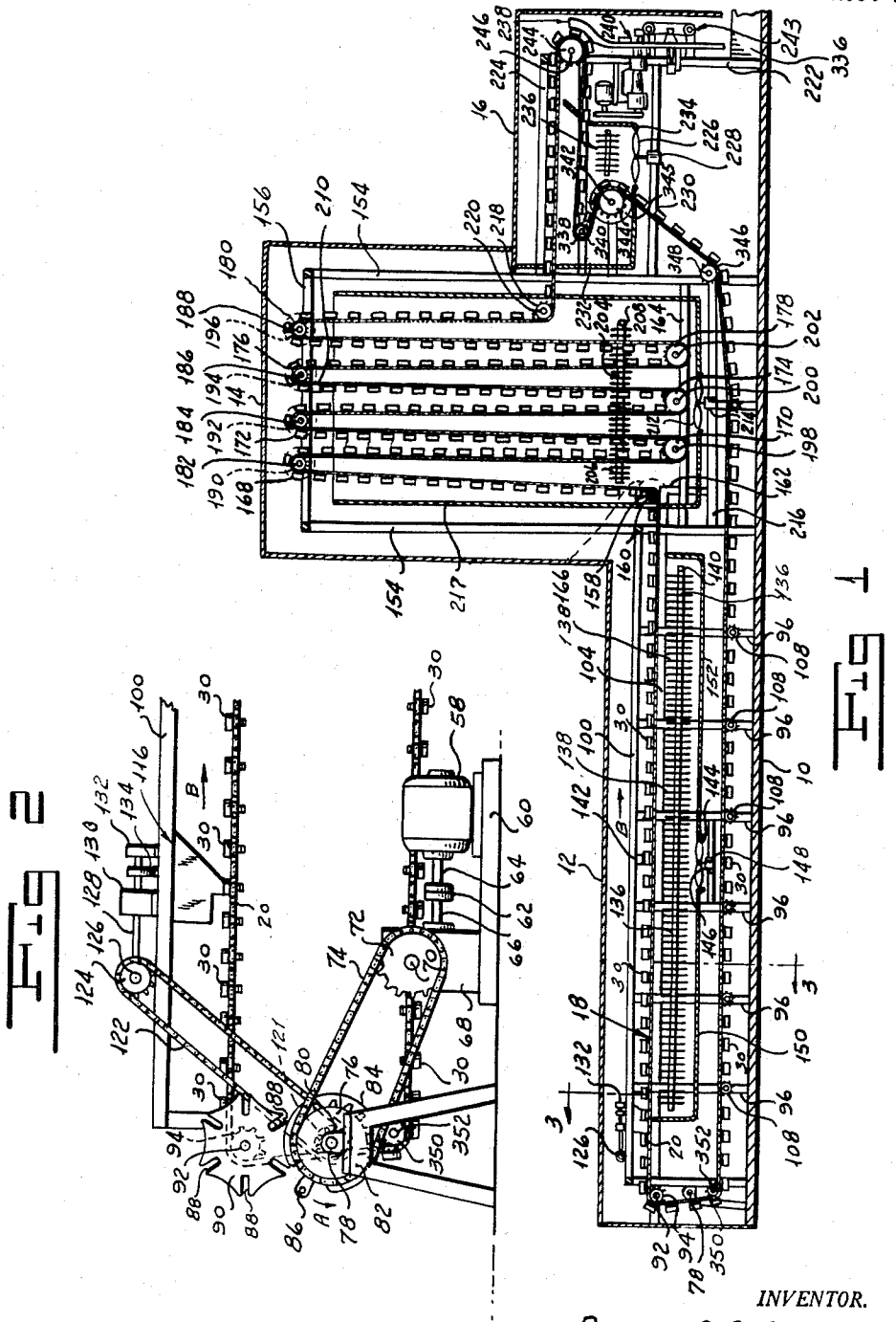


FIG. 1

FIG. 2

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4 Sheets-Sheet 2

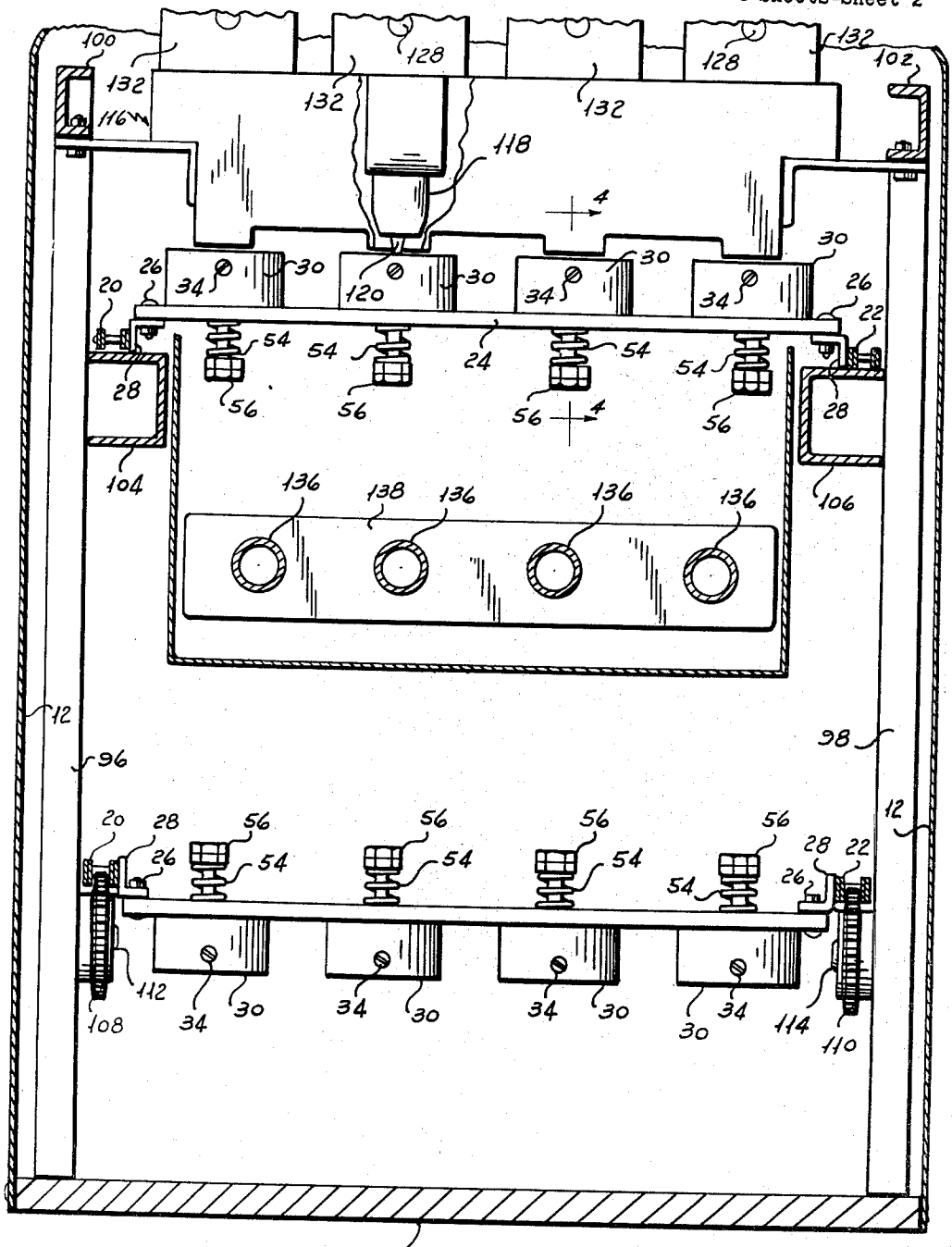


FIG 3

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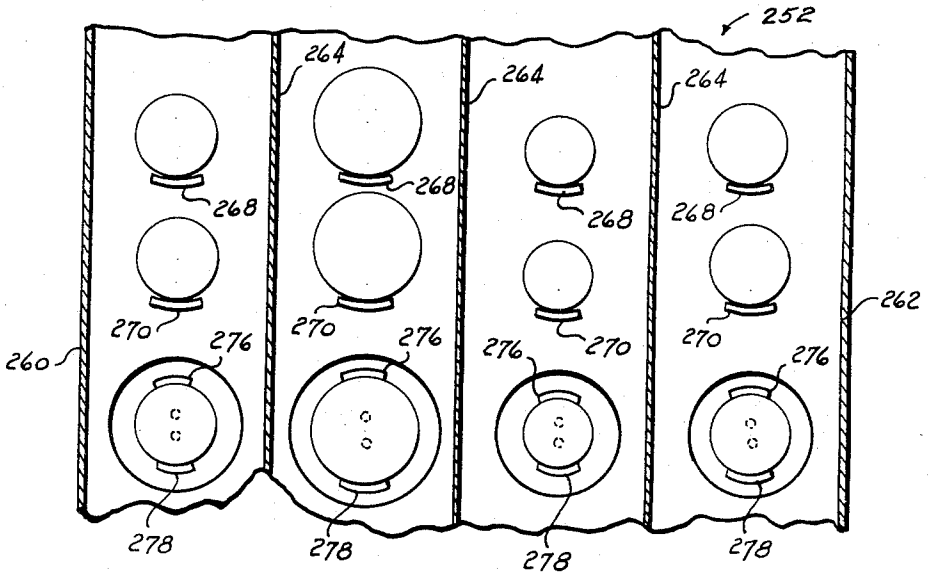


Fig 6

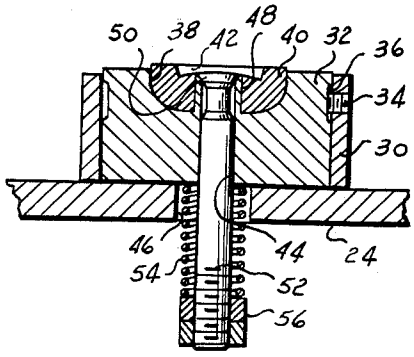


Fig 4

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4 Sheets-Sheet 4

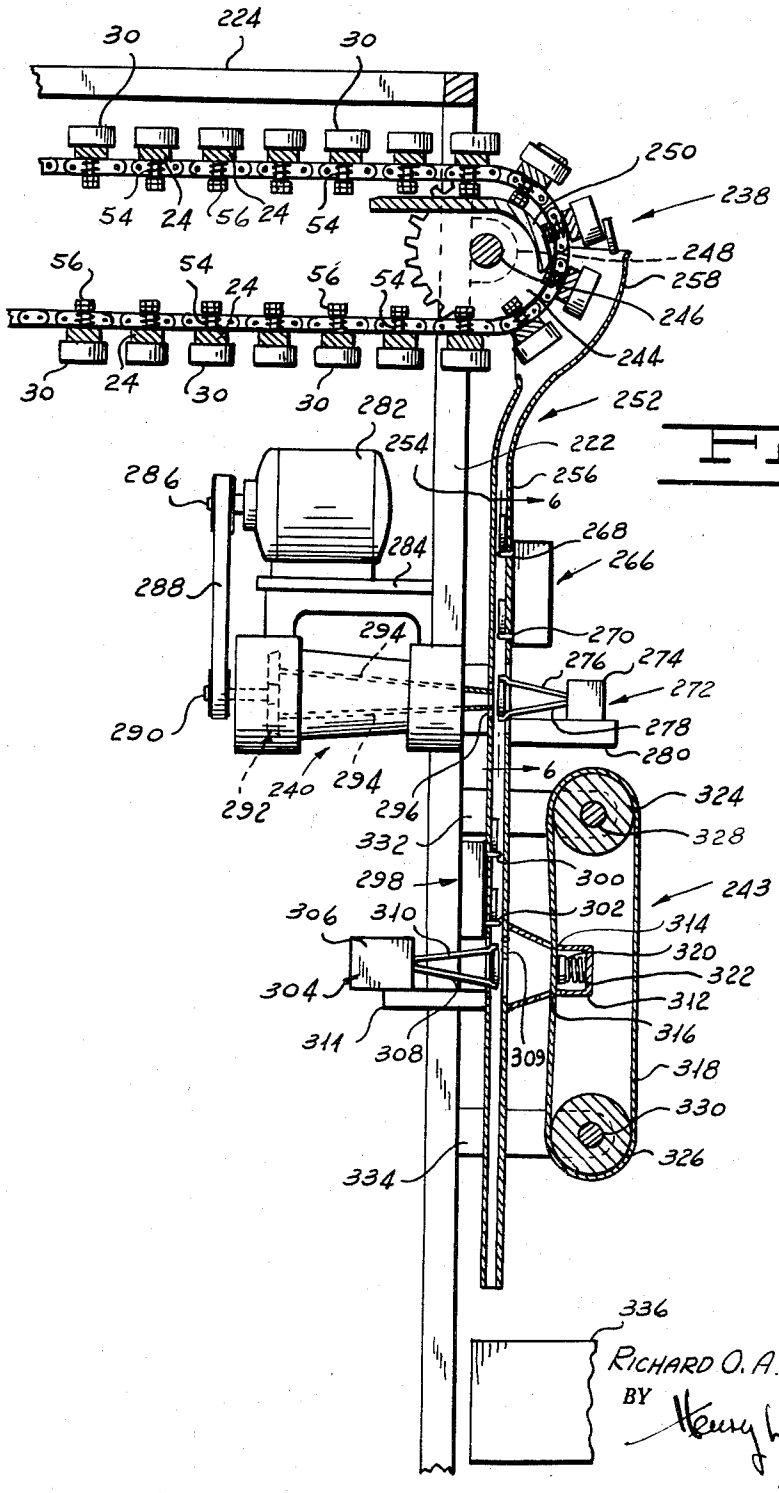


Fig 5

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United States Patent Office

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METHOD FOR CASTING BUTTONS AND THE LIKE

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3 Claims. (Cl. 18—47.5)

My invention relates to an improved method for casting buttons and the like, and more particularly to an improved method and apparatus in which buttons and other castable plastic articles may be made in large quantities at low cost.

In the prior art plastic articles are often formed by methods which involve separate stamping and forming operations. It will be appreciated that much handling is involved before the article assumes its final shape. Further, in stamping operations there is a certain amount of waste in the plastic sheet from which article blanks are stamped. Casting is an economical method of forming plastic articles into very nearly their final form in a single operation. Economy is especially important where the cost of the raw material is a relatively large percent of the total cost of the finished article.

In the manufacture of low cost production items such as buttons, casting methods known to the art have not proved economically feasible. Known casting methods employ molds of a hard, durable material such as steel to form the cavity in which the articles are cast. These steel molds are difficult and expensive to form. The cost of the molds is so great as to render casting an impractical method for forming a low cost, short run item such as a novelty button. These molds cannot readily be altered to a new configuration so as to, for example, make a new design or pattern on the face of a button or the like. If a design change is desired, a completely new mold must be made. Then too, if for any reason the mold becomes damaged it must be completely remade, with a resulting loss to the manufacturer.

Manufacturing methods of the prior art employing casting also involve a number of separate operations or steps which make the rate of production so low that low cost items such as buttons cannot economically be produced. In casting methods of the prior art, a charge of plastic material is injected into a mold and is cured by the application of heat and pressure. If buttons are to be cast, the button blank must first be removed from the mold by some means and then be subjected to a drilling operation and finishing operations. As a result of the manner in which casting methods of the prior art are performed, the rate of production is not sufficiently high to justify their employment.

I have invented an improved method for continuously casting plastic articles such as buttons or the like. My method automatically and continuously produces finished articles from a supply of appropriate raw material. I have also invented apparatus by means of which my improved method may be performed in a rapid, convenient, economic and expeditious manner.

One object of my invention is to provide an improved method for casting plastic articles such as buttons or the like in a convenient, expeditious, rapid and inexpensive manner.

A further object of my invention is to provide an improved method for continuously producing finished

plastic articles such as buttons or the like from a supply of raw plastic material.

Other and further objects of my invention will appear from the following description.

In general, my invention contemplates the provision of an improved method of casting plastic articles such as buttons including the step of depositing by gravity a measured quantity of molten plastic into the mold cavity in which the article is to be formed. I then automatically convey the mold through one or more curing zones. I regulate the temperature of the curing zones and provide a predetermined time of passage of the mold through the zones properly to cure the charge of plastic. The cured plastic charges form articles such as button blanks which I automatically knock out of the mold cavity. When I use my process to form buttons, I pass the blanks automatically first to a drilling unit and then to a sanding unit where respective drilling and finishing operations are performed on the blanks. All operations in my method are automatically accomplished.

One form of apparatus by which my method may be practiced includes a mold assembly having a shell of a hard material such as steel or the like. This shell carries an insert made of soft metal or powdered metal in which I form the mold cavity by means such as hobbing or the like. I provide the mold assembly with a plunger by means of which a cast article, such as a button blank, may be knocked out of the mold.

In the accompanying drawings which form part of the instant specification and which are to be read in conjunction therewith and in which like reference numerals are used to indicate like parts in the various views:

Figure 1 is a sectional view taken along the longitudinal vertical plane of one form of apparatus which may be employed to carry out my improved method.

Figure 2 is a fragmentary side elevation, drawn on an enlarged scale, of the conveyor drive and stepping means for the form of apparatus shown in Figure 1.

Figure 3 is a sectional view, drawn on an enlarged scale and taken along the line 3—3 of Figure 1, of the form of apparatus shown in Figure 1.

Figure 4 is a sectional view, drawn on an enlarged scale and viewed along the line 4—4 of Figure 3, showing my improved casting mold.

Figure 5 is a fragmentary sectional view, drawn on enlarged scale, of the knockout, drilling and sanding stations of the form of apparatus shown in Figure 1, viewed along a vertical, longitudinally extending plane.

Figure 6 is a sectional view, drawn on an enlarged scale, taken along the line 6—6 of Figure 5.

More particularly referring now to Figures 1 to 3 of the drawings, one form of apparatus by means of which I may practice my method includes a base 10 which supports a sheet metal housing which encloses the apparatus. The housing includes a first section 12 for the drive means and initial curing section of the machine. A second section 14 of the housing encloses the final curing or tempering section of the apparatus. A third section 16 of the housing encloses the cooling section of the machine and the machine drilling and sanding units. These will be described in detail hereinafter. My apparatus includes an endless conveyor, indicated generally by the reference character 18. A pair of endless pitch chains 20 and 22 support a plurality of mold assembly carrying bars 24 therebetween. Any convenient means, such as bolts 26, secure the respective ends of bars 24 to brackets 28 carried by chains 20 and 22.

Referring now more particularly to Figures 3 and 4, I mount a number of annular mold shells or die assembly retaining cups 30 at spaced locations along bars 24 by any convenient means, such as welding or the like. Each of the shells 30 carries a retainer 32 formed of steel or

a similar hard metal. Set screws 34 engage locating grooves 36 in retainers 32 to hold them within the shells 30. I form each of the retainers 32 with an annular recess 38 in which I place a soft metal insert 40 which forms the cavity 42 in which the article is molded. I form insert 40 of any appropriate soft metal or powdered metal which may be hobbed to form a cavity 42 having the desired configuration. Hobbing is a method of die sinking in which a hardened master punch, a duplicate of the part to be formed, is pressed into an unheated die blank to reproduce the shape of the hob in the die impression. I prefer to use this method to form the cavity 42 since it is considerably simpler to machine the surface of the hob than to machine the die cavity. Moreover, a single hob can be used for a series of duplicate dies. The soft metal used may be lead, copper, silver, brass, or an alloy of lead or copper or the like. Advantageously, annealed beryllium copper is used, since it has the property of work-hardening when hobbed. The material which forms insert 40 is governed to some extent by the plastic material being cast. For example, if a polyester is the plastic being cast, I preferably form insert 40 of a material such as lead rather than copper, since copper acts as a catalyst for polyester resins.

When forming the die cavity 42 of powdered metal, I first press or hob the powder at room temperature and then sinter it in a suitable atmosphere at a temperature which is approximately two-thirds of the melting point of the powder. Alternately, I may press the powder at such a high temperature that sintering takes place at the same time as the pressing. I prefer to press and sinter the powder in separate operations since simultaneous performance of these operations may involve complicated equipment. Any suitable metal powder, such as iron powder or the like, may be used. Mixtures of different metal powders may be used to form alloys. Bronzes and gun metals, for example, can be produced with an accuracy and uniformity not attainable with foundry methods. The dimensions of the die cavities formed by powdered metal inserts 40 may be held to close tolerances since the dies or hobs for forming the powder compress can be accurately made. The dimensions can be further improved by repressing and coining so that the finished cavity is extremely accurate.

I form each of the retainers 32 with a central bore 44 which registers with an opening 46 in the support bar 24 which carries the retainer. A cylindrical extension 48 of retainer 32 forms a continuation of bore 44 above the lower surface of recess 38 as viewed in Figure 4. The upper end of the cylindrical extension 48 forms a seat for the head or valve 50 of a knockout pin 52 disposed in bore 44. This valve 50 seals the mold cavity. A spring 54 bears with one end against the base of retainer 32 and with its other end on a nut 56 carried by the threaded end of pin 52 remote from head 50. Spring 54 normally urges valve 50 against its seat formed by the extension 48 of the retainer 32.

It will be appreciated that when buttons are being manufactured, the portion of the mold cavity 42 formed by the upper surface of valve 50 forms that part of the button in which button holes are to be drilled. The portion of insert 40 surrounding valve 50 is hobbed to form the button pattern. It will readily be appreciated that the pattern or design of the button may be varied by using different hobs on the soft metal insert 40. Valve 50 permits this change since the portion of the button formed by the surface of valve or head 50 does not vary from button to button.

Referring again to Figures 1 and 2, I provide a drive motor 58 supported on a platform 60 on base 10 for driving the pitch chains 20 and 22 to carry the mold assemblies through the various stations of the apparatus to be described hereinafter. A flexible coupling 62 connects the shaft 64 of motor 58 with the input shaft 66 of a gear box 68. The output shaft 70 of gear box 68 drives a sprocket wheel 72 which engages and drives a pitch chain 74. Chain 74 in turn drives a sprocket wheel 76 carried by a shaft 78 rotatably mounted in a bearing 80 supported on a stand 82. Shaft 78 carries for rotation therewith the drive member 84 of a Geneva intermittent drive mechanism. When shaft 78 rotates, a pin 86 carried by member 84 engages in a slot 88 of a Geneva wheel 90. One of the portions of wheel 90 between a pair of adjacent slots 88 engages the surface of drive wheel 84 when pin 86 is out of engagement with the slot 88 to arrest the movement of the chains 20 and 22 between steps. The shaft 92 which mounts the Geneva wheel 90 also carries for rotation therewith a pair of sprocket wheels 94, one of which is shown in phantom in Figure 2, which wheels engage and drive the respective pitch chains 20 and 22. As the drive member 84 makes one revolution in the direction of the arrow A in Figure 2, the chains 20 and 22 drive through a single step in the direction of the arrow B in Figure 2.

As can be seen by reference to Figures 1 and 3, within the housing section 12 which encloses the preliminary curing stage of my apparatus and adjacent the respective sides thereof, I mount a plurality of spaced uprights 96 and 98 on the base 10. Uprights 96 and 98 support respective horizontally extending structural members 100 and 102 to form one part of the framework for supporting the working parts of the apparatus in a manner to be described. I fix a first guide member, such as a channel iron 104 or the like, to the uprights 96. This guide member, together with a second horizontally extending guide member 106 fixed to uprights 98, supports the conveyor 18. As can be seen by reference to Figure 3, the upper or advancing portions of the chains 20 and 22 ride along the upper surfaces of the respective guides 104 and 106. These smooth, continuous guides support the conveyor so that the mold assemblies carried thereby in which charges of plastic material have been deposited travel smoothly without vibration and smooth castings result. They also permit the use of a smaller and less expensive chain than would otherwise be necessary. The return portion of conveyor 18 in the section 12 which carries mold assemblies from which button blanks have been removed is supported in its travel through section 12 by a plurality of idler sprocket wheels 108 and 110 carried by respective pins 112 and 114 on the uprights 96 and 98.

Immediately preceding the entry of the mold assemblies into the preliminary curing stage enclosed by section 12, I deposit a measured amount of molten plastic into the mold cavities 42. As can be seen by reference to Figure 3, I mount four mold assemblies in spaced relationship on each of the support bars 24. This is by way of illustration only, it being understood that as many mold assemblies as desired may be mounted on each of the bars 24. In one form of my apparatus I provide one thousand bars 24 along the length of the conveyor 18.

I provide a tank, indicated generally by the reference character 116, containing the supply of molten plastic which is to be deposited in measured amounts in the mold cavities 42. As can best be seen by reference to Figure 3, I provide a positive displacement pump 118 for each of the mold assemblies carried by a bar 24. In the form of my apparatus shown, I provide four such pumps. Pumps 118 are submerged in the molten plastic carried within the reservoir 116. They may be simple two-valve pumps of any type known to the art which deliver a measured volume of liquid plastic per operation. The nozzle 120 of each of the pumps 118 extends through the bottom of tank 116 and registers with the cavity 42 of a die assembly which has been moved thereunder. Submerging of pumps 118 in the molten plastic simplifies the apparatus, since the necessity for packing the pump and maintaining it at a temperature which prevents the plastic from solidifying is eliminated.

I provide a drive means for operating pumps 118 to deposit measured quantities of molten plastic in the respective die cavities 42 which move thereunder on each operation of the machine. More particularly referring to Figures 2 and 3, shaft 78 carries for rotation therewith a sprocket wheel 121 which drives a pitch chain 122 to drive a sprocket wheel 124 fixed on a shaft 126 for rotation therewith. Bearings (not shown) carried by frame members 100 and 102 rotatably support shaft 126. Shaft 126 drives bevel gearing or the like (not shown) to drive the operating shafts 128 of the pumps 118. Shafts 128 may conveniently be supported in bearings 130 and 132 carried by the machine frame. Cams 134 operated by shafts 128 drive pumps 118 in timed relation with the advance of conveyor 18 to deposit measured quantities of fluid plastic within the mold cavities moved under the pump nozzles 120. From the structure thus far described it will be understood that Geneva wheel 90 steps conveyor 18 successively to move the bars 24 of conveyor 18 underneath the nozzles 120 on successive revolutions of shaft 78. Shafts 128 are continuously driven to actuate cams 134 to deposit measured quantities of plastic in the cavities 42 as a bar carrying a row of cavities moves under the pump nozzles.

The plastic material of which I form my plastic articles, such as buttons or the like, may be any castable thermosetting or thermoplastic synthetic resin. Castable resins generally have a high shrink factor which prevents sticking of the cast articles to the mold cavity. This characteristic permits ready ejection of the completed casting from the mold. In the case of a polyester resin the shrinkage is as much as six percent. While any castable resin may be employed, materials, such as polystyrene and acrylic resin, which are deleteriously affected by dry-cleaning fluids are not the most desirable materials from which to form buttons. I may advantageously use a polyester resin, a phenol formaldehyde or phenol furfural casting resin compounds, an epoxy casting resin, a polysulphide and epoxy casting resin, a glyceryl phthalate casting resin, an allyl casting resin, a polyester casting resin, a polyacrylic ester, a methyl-methacrylate casting resin, or any other suitable casting resin. Preferably, I employ a thermosetting resin, such as a polyester resin. When I employ material of this nature, I maintain the first or preliminary curing stage of the apparatus enclosed by housing section 12 at a temperature of approximately 260° F. and regulate the time of passage of a mold assembly through the zone to about ten to twelve minutes. I maintain the second curing stage of the apparatus enclosed by housing section 14 at a temperature of from about 180° F. to 210° F. and regulate the time of passage of a mold assembly therethrough to about eighteen to twenty minutes. The section 16 of the machine in such case may conveniently be a cooling section maintained at room temperature. It is to be understood that if a thermoplastic rather than a thermosetting resin is employed, the plastic material must be given an initial chill in the section enclosed by housing section 12. In this case the section enclosed by housing section 14 provides a tempering section for the thermoplastic material. Within the initial or preliminary curing section of the machine enclosed by housing section 12, I mount a plurality of pipes 136 which support radiating fins 138. A manifold 140 supplies pipes 136 with a heating medium when a thermosetting plastic is being used. It is to be understood, of course, that where the thermoplastic material is employed, I supply a cooling medium to pipes 136 through manifold 140. A thermostat 142 carried by frame member 100 controls the temperature at which the heating or cooling medium is supplied to pipes 136. This may be accomplished by any other convenient means known to the art.

In order to prevent the occurrence of localized hot spots and to ensure an even temperature throughout the portion of the apparatus enclosed by housing section 12, I mount a circulating fan 144 on a bracket 146 carried by a pair of uprights 96. A motor 148 drives fan 144 to circulate air throughout the preliminary curing section. A pair of baffles 150 and 152 supported between uprights 96 and 98 directs the flow of air through the initial curing stage in a manner to ensure an even temperature in the section.

Mold assemblies carrying charges of plastic material and moving in the direction of the arrow B in Figure 1 leave the preliminary curing section and enter the final curing or tempering section enclosed by housing section 14. Within section 14 I mount a plurality of spaced uprights 154 on the base 10 and connect them at their upper ends by structural members 156 to form a substantially rectangular supporting framework. As the conveyor chains 20 and 22 pass from section 12 to section 14 they engage sprocket wheels 158 carried by a shaft 160 for rotation therewith. Shaft 160 is rotatably supported by any convenient means on a bracket 162 carried by frame members 164 fixed to uprights 154. I provide a separate friction drive 166 for sprocket wheels 158. This friction drive, together with other friction drives to be described hereinafter, enables the Geneva mechanism including wheel 90 to step the conveyor 18 smoothly. In other words, these friction drives assist the Geneva wheel drive in overcoming the inertia of the conveyor and mold assemblies carried thereby. When pin 86 is not in engagement with the wheel 90, the friction drives slip and the conveyor 18 does not move until the Geneva mechanism engages.

After passing around sprocket wheels 158, chains 20 and 22 are led successively upwardly and downwardly a predetermined number of times within the section 14. It will be understood that the plastic deposits in the mold assembly have by this time congealed to an extent sufficient to prevent their flowing by gravity. After entering section 14, chains 20 and 22 pass successively around sprocket wheels 168, sprocket wheels 170, sprocket wheels 172, sprocket wheels 174, sprocket wheels 176, sprocket wheels 178 and sprocket wheels 180. Sprocket wheels 168, 172, 176 and 180 are carried for rotation therewith on respective shafts 182, 184, 186 and 188, rotatably supported by any convenient means on members 156. I provide respective friction drives 190, 192, 194 and 196 for shafts 182, 184, 186 and 188. These friction drives act in the same manner as does the friction drive 166 to assist the Geneva drive mechanism and prevent jerky and irregular movements of conveyor 18. Sprockets 170, 174 and 178 are carried by respective shafts 198, 200 and 202 for rotation therewith. Structural members 164 rotatably support shafts 198, 200 and 202 in a conventional manner.

As has been explained hereinabove, the section of the machine enclosed by housing section 14 must be maintained at the proper temperature to effect the final curing or tempering of the plastic castings. To accomplish this I mount a plurality of pipes 204 within section 14 on any suitable supporting mechanism. Fins 206 connect pipes 204 which are supplied with a heating or cooling medium by a manifold 208. I govern the temperature at which I supply the heating or cooling fluid for manifold 208 in a conventional manner by a thermostat 210. If I use a polyester resin as the plastic material, I maintain this section of my apparatus at a temperature of from about 180° F. to 210° F. The time of passage of a mold assembly through this section is approximately eighteen to twenty minutes. In order to circulate air through the section enclosed by housing section 14 to ensure an even heat distribution, I dispose a fan 212 below pipes 204. A motor 214 supported by a bracket 216 on the frame drives fan 212. A rectangular baffle 217 carried by the frame in a sutiable manner ensures proper circulation of the air in the section.

A pair of idler sprocket wheels 218 carried by a shaft

220 for rotation therewith directs the chains 20 and 22 of conveyor 18 from the section enclosed by housing 14 to the section of the apparatus enclosed by housing section 16. The apparatus enclosed by section 16 includes a pair of uprights 222 connected by structural members 224 to uprights 154. Members 222 and 224 form a supporting structure for the knockout, drilling and finishing units of my apparatus. The portion of the apparatus between the final curing section and the knockout and finishing units is at room temperature. It is desirable that some means be provided for circulating the air in this section. I provide a fan 226 driven by a motor 228 supported on the structural members 230. Baffles 232 and 234 properly direct the air to ensure an even temperature throughout the section. If desired, refrigerating means, indicated generally by the reference character 236, may be provided in this section. In the section enclosed by housing section 16, the plastic articles, such as button blanks or the like, pass successively to a knockout unit, indicated generally by the reference character 238, a drilling unit, indicated generally by the reference character 240, and a sanding unit, indicated generally by the reference character 243.

After leaving sprocket wheels 218, chains 20 and 22 pass to respective sprocket wheels 244 fixed on a shaft 246 for rotation therewith. As can be seen by reference to Figure 5, I mount shaft 246 in bearings 248 carried by a pair of respective uprights 222. The knockout unit 238 includes a cam plate 250 supported between sprocket wheels 244 in any convenient manner. I form the outer surface of cam plate 250 to engage the nuts 56 on the ends of knockout pins 52 of the mold assemblies. As a bar 24 carrying a group of mold assemblies passes around shaft 246, the knockout pins 52 of the mold assemblies carried on the bar are moved against the action of springs 54 to knock the cured plastic articles, such as button blanks or the like, out of the mold cavities 42. I mount a button guide, indicated generally by the reference character 252, on frame members 222 in a position to catch the button blanks or the like being ejected from the mold assemblies by knockout pins 52. Guide 252 includes a pair of walls 254 and 256, wall 256 of which extends upwardly as viewed in Figure 5 at 258 to catch the button blanks. As can be seen by reference to Figure 6, the guide 252 is closed by sides 260 and 262 and is divided into a number of channels by partitions 264.

I mount a button blank feeding escapement, indicated generally by reference character 266, on wall 256 of guide 252 immediately preceding the drilling unit 240. Button blank feeder 266 includes a plurality of reciprocable fingers 268 and a plurality of reciprocable fingers 270 disposed below fingers 268 in guide 252. Suitable drive means (not shown) operates fingers 268 and 270 to move fingers 268 into guide 252 when fingers 270 are withdrawn and to move fingers 270 into guide 252 when fingers 268 are withdrawn. This action feeds the button blanks coming from each line of mold assemblies on conveyor 18, one by one to the drilling unit 240. The drilling unit 240 includes a number of button blank catching and holding units, indicated generally by the reference character 272. Each unit 272 includes a reciprocable carriage 274 which pivotally mounts a pair of button catching fingers 276 and 278. A housing 280 carried by side 256 mounts carriage 274. At the same time as finger 270 releases a button blank, drive means housed by carriage 274 pivots finger 278 to a position within guide 252 where it catches the blank. Finger 276 moves to grip the button and carriage 274 moves under the influence of drive means in housing 280 to hold the button blank against the wall 254.

Drilling unit 240 also includes a drive motor 282 carried by a platform 284 supported by uprights 222. Shaft 286 of motor 282 drives a belt 288 which drives the input shaft 290 of a planetary gear system, indicated generally by the reference character 292. Gear system 292 drives the drilling spindles 294 of the unit. After fingers 276 and 280 move a button blank against wall 254, means (not shown) moves spindles 294 through an opening 296 in wall 254 to drill button holes in the blank. It is to be understood that there are as many groups of spindles 294 and units 272 as there are mold assemblies on a bar 24. When a drilling operation is completed, spindles 294 are withdrawn, carriage 274 moves to the right, as viewed in Figure 5, and fingers 276 and 278 open to release the drilled button blank. I arrange my apparatus to perform a predetermined number of knockout operations per unit of time at the unit 238. I also arrange feeding unit 266 and drilling unit 240 to perform a greater number of operations per unit of time than are performed by the knockout unit. This ensures that no pile-up of buttons occurs on top of finger 268. It is also to be noted that, as can be seen by reference to Figure 6, my button feeding unit 266 is adapted to handle a variety of sizes of buttons simultaneously. Sufficient space is left between fingers 268 and 270 to permit this operation.

Below the drilling unit and in the path of drilled button blanks coming from unit 240, I provide a second button blank feeding escapement, indicated generally by the reference character 298. Escapement 298 is supported by any convenient means between uprights 222 and includes a plurality of reciprocable fingers 300 and a plurality of reciprocable fingers 302 disposed below fiingers 300. Control means (not shown) ensures that when fingers 300 are within guide 252 fingers 302 are withdrawn, and when fingers 302 are within guide 252 fingers 300 are withdrawn. This operation ensures that button blanks are fed one by one to the sanding unit 243 of the machine. The sanding unit 243 includes a plurality of button gripping and holding units 304. Each unit 304 includes a carriage 306 pivotally mounting a pair of fingers 308 and 310, and a housing 311 which mounts carriage 306 for reciprocating movement. The operation of units 304 is the same as the units 272. A button fed by a finger 302 to a pair of fingers 308 and 310 is gripped thereby and advanced by carriage 306 through openings in walls 254 and 256 and into a housing 312 formed in wall 256. A pivoted gate 309 carried by wall 256 blocks the entry to housing 312 to prevent a button from falling therein when it is caught by finger 308 and before it is engaged by finger 310. When carriage 306 moves to the right, it opens gate 309. Housing 312 has a pair of openings 314 and 316 through which the belt 318 of the sanding unit extends. The belt 318 may be provided with any suitable sanding material, such as an open grid carborundum. A spring 322 resiliently urges a bar or the like 320 in housing 312 against the portion of belt 318 which engages the buttons during the sanding operation. A pair of rolls 324 and 326 carried by respective shafts 328 and 330 for rotation therewith support belt 318. Suitable drive means (not shown) drives one of the shafts 328 or 330 to drive the sanding belt 318. Brackets 332 and 334 on uprights 222 rotatably support respective shafts 328 and 330. When a sanding operation has been performed, carriage 306 moves to the left, as viewed in Figure 5, and fingers 308 and 310 open to permit the button to drop down, through, and out of guide chute 252 into a suitable receptacle 336. The sanding operation performed by unit 243 is necessary to remove the edge of the meniscus formed when a charge of plastic material is deposited in a mold cavity 42. This meniscus edge is forced against belt 318 by carriage 306. I arrange my sanding unit 243 to perform operations at a greater rate than the rate at which operations are performed by the drilling unit 240. This arrangement prevents a pile-up of button blanks on fingers 300. It is to be understood that the number of units 304 is equal to the number of channels in guide 252. A single belt 318 extending across all

channels or a plurality of belts, one for each channel, may be provided as desired. It is to be understood further that the showing of the knockout, drilling and sanding units of my apparatus is schematic only. Other specific forms of apparatus known to the art may be employed. For example, rotating cams (not shown) may replace the knockout member **250** and other known means may replace the button catching and holding units **272** and **304**, as will readily be understood by those skilled in the art.

Referring again to Figure 1, after the button blanks have been knocked out of the mold assemblies, the conveyor **18** passes around idler sprocket wheels **338** carried by a shaft **340** for rotation therewith. I mount shaft **340** by any convenient means on the machine frame. A shaft **342** rotatably mounted on the machine frame carries sprocket wheels **344** for rotation therewith. A friction drive **345** drives shaft **342** to aid the Geneva drive mechanism in stepping the conveyor. Idler sprocket wheels **346** carried by a shaft **348** for rotation therewith direct chains **20** and **22** to the idler sprocket wheels **108** and **110** carried by uprights **96** and **98**. Idler sprocket wheels **108** and **110** guide the chains back to idler sprocket wheels **350**, which direct the chains to sprocket wheels **94**. A shaft **352** rotatably carried by the machine frame carries sprocket wheels **350** for rotation therewith. It will be appreciated that I preheat the mold assemblies including cavities **42** during their passage through the space below the initial curing zone. This preheating aids in ensuring a smooth molded product.

In the practice of my method for casting plastic articles such as buttons or the like, I step conveyor **18** to position a bar **24** carrying a number of mold assemblies under the reservoir **116**. It is to be understood that before performing this step, I preheat the mold assemblies during their passage under the initial curing section of the apparatus shown. Pumps **118** deposit by gravity measured quantities of plastic material in the empty mold cavities **42** below reservoir **116**. As has been explained hereinabove, I synchronize the operation of pumps **118** with the stepped advance of conveyor **18**. After the deposit of charges of molten plastic in cavities **42**, I advance the cavities **42** through the initial curing section of the apparatus enclosed by housing section **12**. Pipes **136** heat or cool the initial curing zone depending on whether a thermosetting or thermoplastic material, respectively, is being used. Thermostat **142** and fan **144** ensure an even predetermined temperature within this initial curing section. The time of passage of a mold assembly through the initial curing section is governed by the length of the section and the speed of advance of conveyor **18**. When using a thermosetting polyester resin, I govern these factors to provide an initial curing time of from ten to twelve minutes. The temperature of the section is maintained at approximately 260° F.

After having passed the molds through the initial curing section, I provide a second curing stage by means of the section of the apparatus enclosed by housing section **14**. If the casting material is a polyester resin, the heating pipes **204** heat this section to a temperature of from about 180° F. to 210° F. Thermostat **210** regulates this temperature and fan **212** ensures an even temperature throughout the section. The length of the conveyor **18** in housing section **14** is such in relation to the speed of advance of the conveyor that a curing time of from about eighteen to twenty minutes is provided. Where a thermoplastic resin is being used, the stage of operation performed by the apparatus enclosed in section **14** is a tempering stage.

Following the final cure or tempering stage, I provide a cooling stage in housing section **16**. I may maintain this section at room temperature or I may provide it with refrigerating means **236** carried by the frame of the apparatus, if desired. A fan **226** ensures an even temperature distribution in this section.

As the conveyor **18** passes around sprocket wheels **244**, I knock the formed articles, such as button blanks, out of the mold cavities **42** owing to the action of cam plate **250** on knockout pins **52**. I convey the ejected button blanks to the escapement mechanism **266** by guide **252**. Escapement mechanism **266** feeds the button blanks from each line of mold assemblies on conveyor **18**, one by one, to the drilling unit **240** which performs the drilling operation. A second escapement mechanism **298** disposed below the drilling unit feeds drilled button blanks to the sanding unit **243** described hereinabove. After sanding, the buttons pass out of guide **252** into a suitable receptacle **336**.

One form of apparatus capable of carrying out my improved method includes the mold assembly for the soft metal insert **40** which provides the mold cavities **42**. As has been explained hereinabove, this mold assembly includes a knockout pin **52** which automatically ejects a plastic blank from cavity **42**. It is to be noted that the head **50** of knockout pin **52** seats against a seat provided by the extension **48** and acts as a seal or valve to prevent plastic deposited in the cavity **42** from seeping down into the bore **44**. The soft metal insert **40** may readily be formed to a desired pattern by hobbing with a steel hob. If a pattern change is to be made, the soft metal insert **40** may readily be rehobbed. This can be accomplished more inexpensively than can the manufacture of a new steel mold as is necessary in casting methods of the prior art.

It will be seen that I have accomplished the objects of my invention. I have provided an improved method for casting plastic articles, such as buttons or the like, in a rapid, expeditious and inexpensive manner. My improved method enables me continuously to produce finished articles such as buttons. My improved method eliminates the waste incident to button manufacturing processes of the prior art. I have provided improved apparatus by means of which my method may be practiced. This apparatus includes a mold, the design of which may readily and inexpensively be changed. My mold is inexpenisve to form. It is provided with means by which a cast plastic article, such as a button blank or the like, is automatically knocked out of the mold. The apparatus I provide for practicing my method enables me simultaneously to produce buttons of different sizes and patterns. My method and apparatus are adapted continuously to produce finished articles, such as buttons or the like, from a supply of raw material.

It will be understood that certain features and subcombinations are of utility and may be employed without reference to other features and subcombinations. This is contemplated by and is within the scope of my claims. It is further obvious that various changes may be made in details within the scope of my claims without departing from the spirit of my invention. It is therefore to be understood that my invention is not to be limited to the specific details shown and described.

Having thus described my invention, what I claim is:

1. A continuous method of making buttons including the steps of conveying a plurality of open molds successively past a molding material feed station, depositing by gravity respective measured charges of heat reactive synthetic resin in the open molds at said feed station, passing said open molds through a curing zone to cure the resin deposits to form button blanks, conveying said molds through an ejecting station, ejecting said button blanks from said molds at said ejecting station as they pass through said station, feeding blanks under the influence of gravity from said ejecting station in timed relationship to a drilling station, receiving and supporting said button blanks at said drilling station, drilling said button blanks at said drilling station and controlling said feeding step to permit said drilling step to be performed on one blank before a succeeding blank is fed to said drilling station.

2. A continuous method of making buttons including the steps of conveying a plurality of open molds successively past a molding material feed station, depositing by gravity respective measured charges of heat reactive synthetic resin in the open molds at said feed station, passing said open molds through a curing zone to cure the resin deposits to form button blanks, conveying said molds through an ejecting station, ejecting said button blanks from said molds at said ejecting station as they pass through said station, feeding blanks under the influence of gravity from said ejecting station in timed relationship to a polishing station, receiving and supporting said button blanks at said polishing station, polishing said button blanks at said polishing station and controlling said feeding step to permit said polishing step to be performed on one blank before a succeeding blank is fed to said polishing station.

3. A continuous method of making buttons including the steps of conveying a plurality of open molds successively past a molding material feed station, depositing by gravity respective measured charges of heat reactive synthetic resin in the open molds at said feed station, passing said open molds through a curing zone to cure the resin deposits to form button blanks, conveying said molds through an ejecting station, ejecting said button blanks from said molds at said ejecting station as they pass through said station, feeding blanks under the influence of gravity from said ejecting station in timed relationship to a drilling station, receiving and supporting said button blanks at said drilling station, drilling said button blanks at said drilling station, controlling said feeding step to permit said drilling step to be performed on one blank before a succeeding blank is fed to said drilling station, feeding blanks under the influence of gravity from said drilling station in timed relationship to a polishing station, receiving and supporting said button blanks at said polishing station, polishing said button blanks at said polishing station and controlling the step of feeding blanks to said polishing station to permit said polishing step to be performed on one blank before a succeeding blank is fed to said polishing station.

References Cited in the file of this patent

UNITED STATES PATENTS

294,490	Merritt et al.	Mar. 4, 1884
356,450	Coleman	Jan. 25, 1887
1,308,753	Crouch	July 8, 1919
1,673,904	Dirzuweit	June 19, 1928
1,958,422	Dinzl	May 15, 1934
2,022,895	Morrell	Dec. 3, 1935
2,097,144	Christensen	Oct. 26, 1937
2,257,068	Parsons	Sept. 23, 1941
2,387,034	Milano	Oct. 16, 1945
2,552,027	Bird et al.	May 8, 1951
2,564,624	Hoos	Aug. 14, 1951
2,652,597	Sucher	Sept. 22, 1953
2,665,452	Beattie	Jan. 12, 1954
2,696,024	Mobley et al.	Dec. 7, 1954
2,732,584	Bishop	Jan. 31, 1956
2,827,665	Rogers et al.	Mar. 25, 1958

FOREIGN PATENTS

564	Great Britain	1904