

May 10, 1927.

G. GOEBEL

1,627,601

APPARATUS FOR COMPACTING GRANULAR MATERIAL

Filed Aug. 18, 1922

8 Sheets-Sheet 1

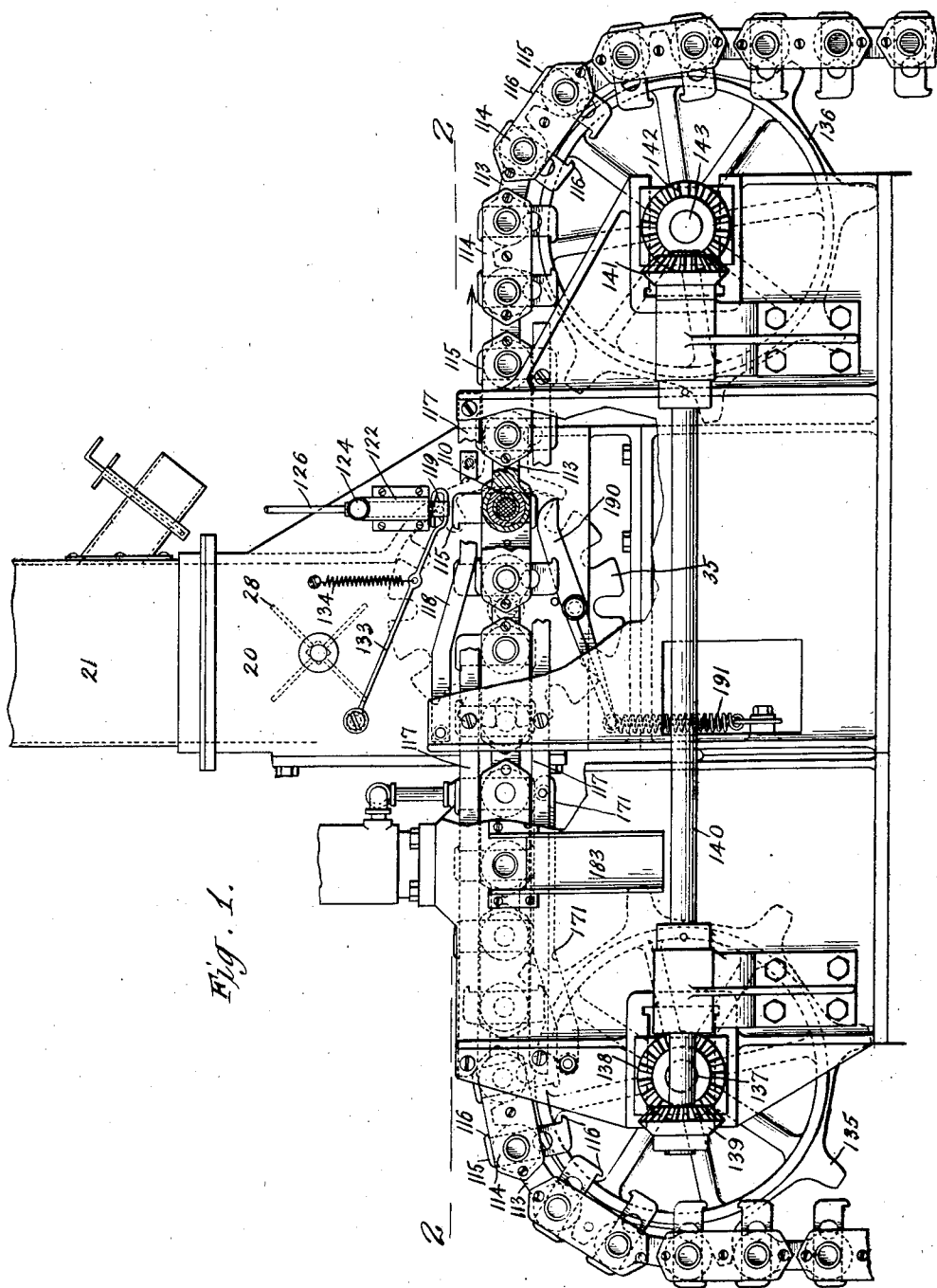


Fig. 1.

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May 10, 1927.

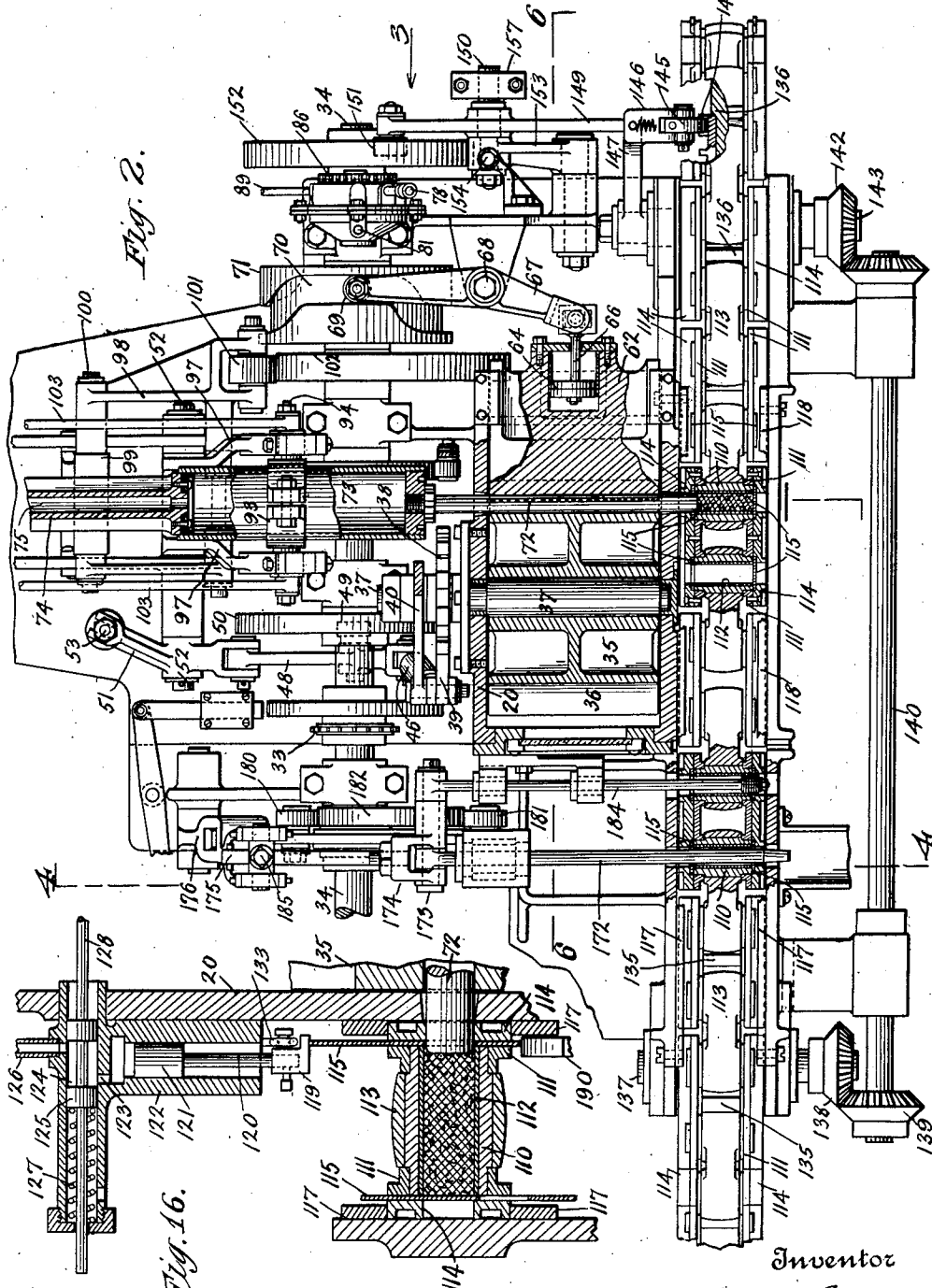
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APPARATUS FOR COMPACTING GRANULAR MATERIAL

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8 Sheets-Sheet 2



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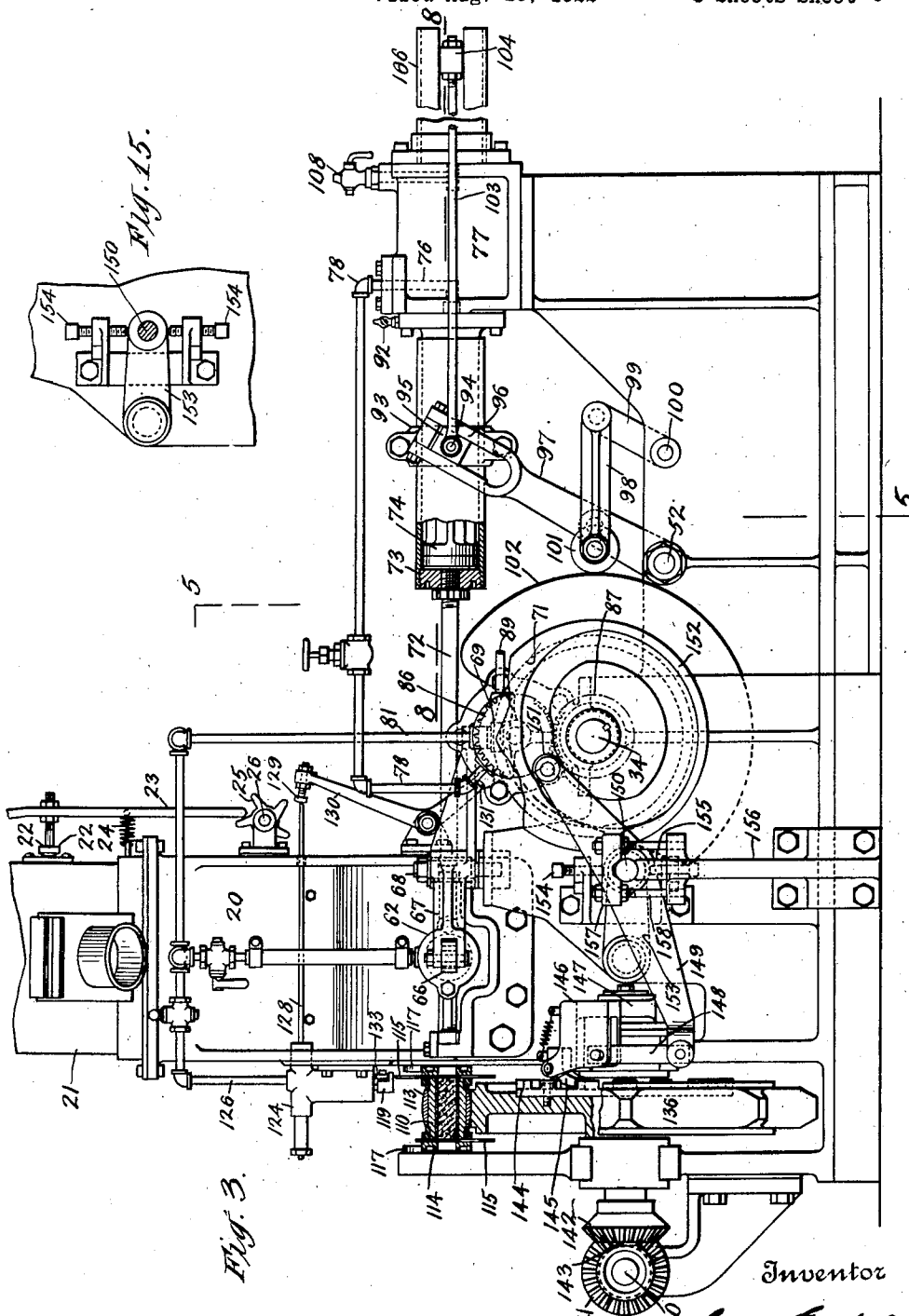
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APPARATUS FOR COMPACTING GRANULAR MATERIAL

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8 Sheets-Sheet 3



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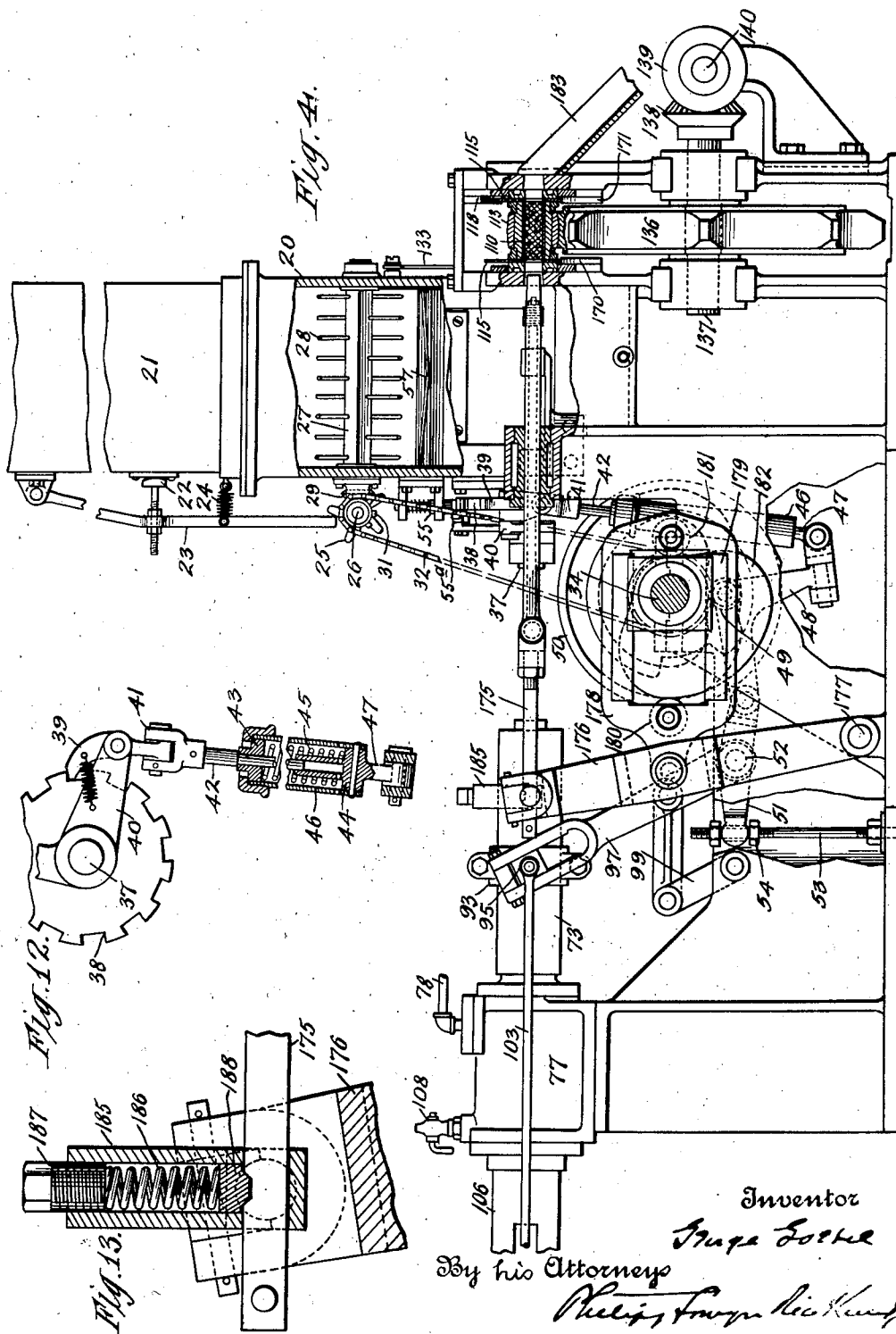
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APPARATUS FOR COMPACTING GRANULAR MATERIAL

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8 Sheets-Sheet 4



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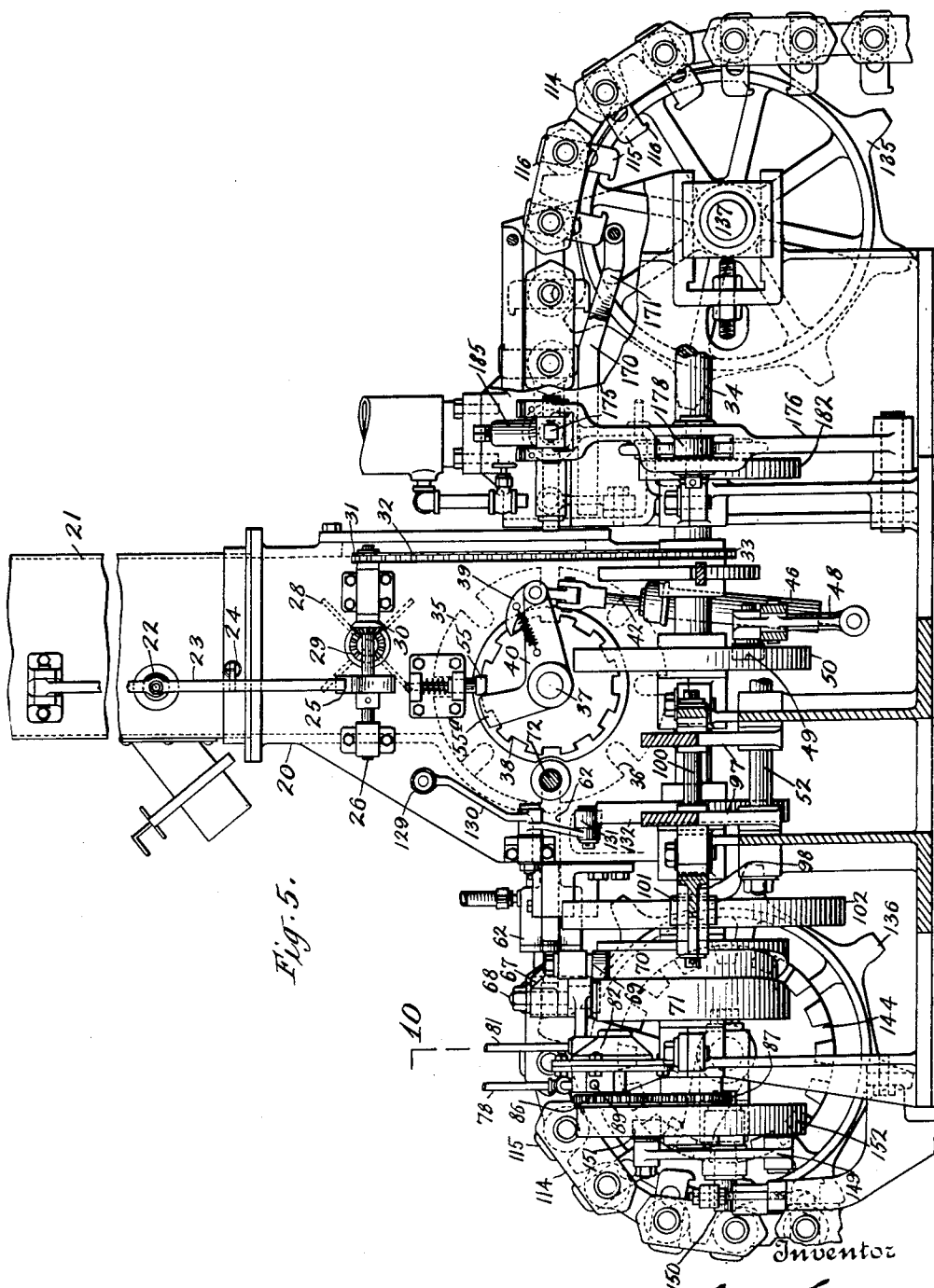
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APPARATUS FOR COMPACTING GRANULAR MATERIAL

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8 Sheets-Sheet 5



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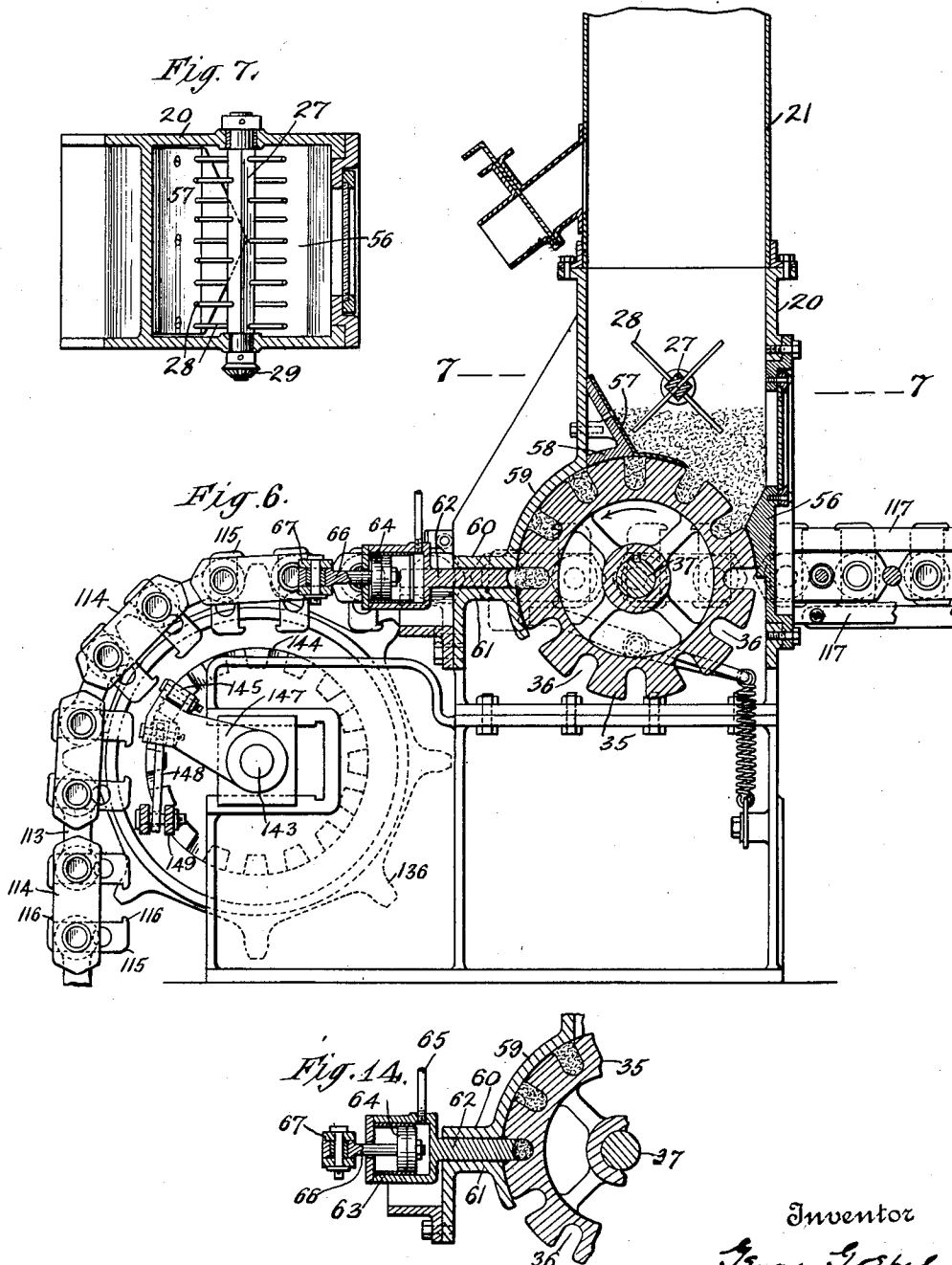
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8 Sheets-Sheet 6



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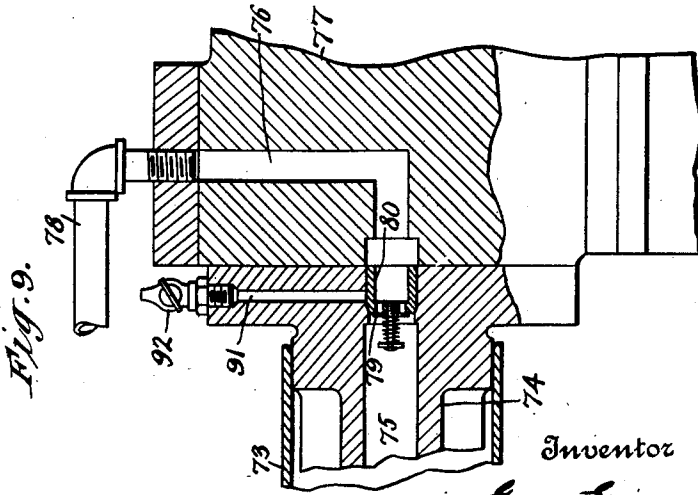
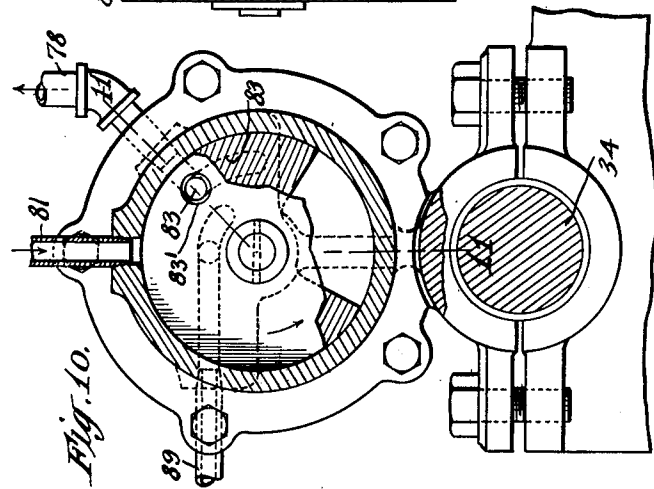
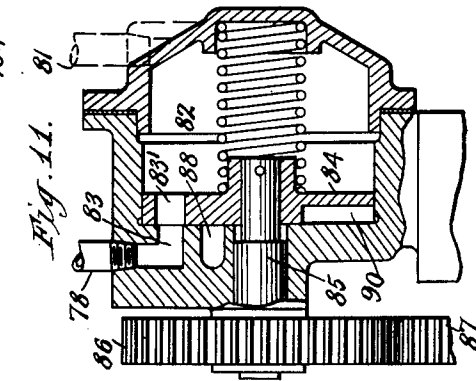
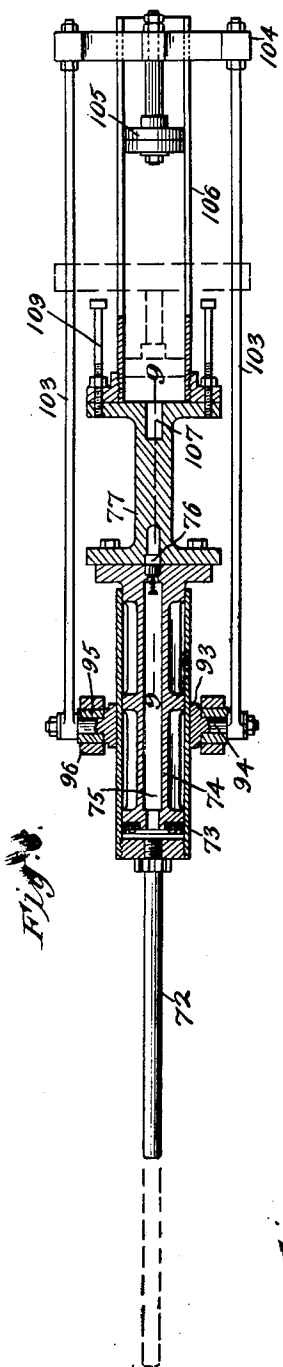
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APPARATUS FOR COMPACTING GRANULAR MATERIAL

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8 Sheets-Sheet 7



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APPARATUS FOR COMPACTING GRANULAR MATERIAL

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8 Sheets-Sheet 8

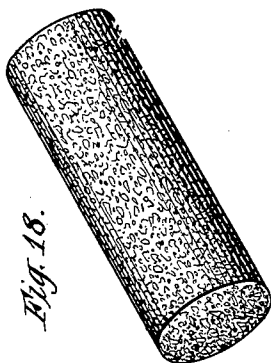
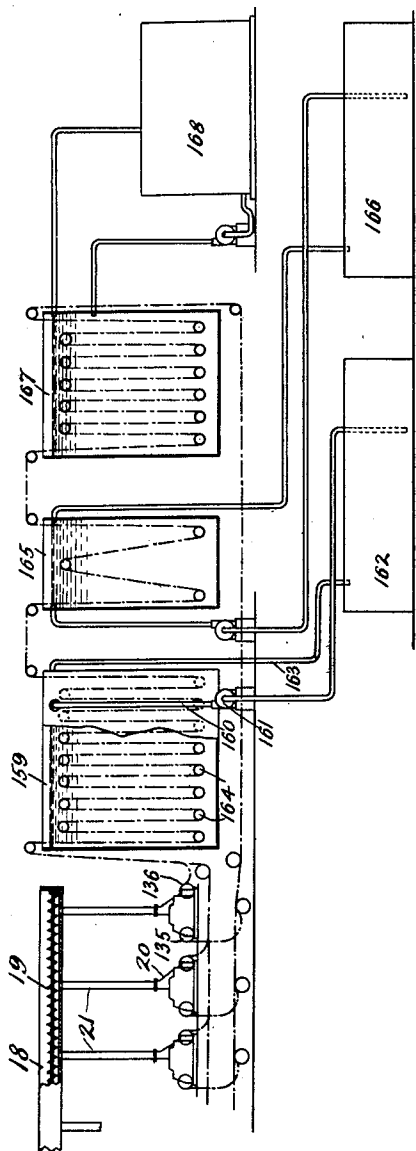


Fig. 17.



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UNITED STATES PATENT OFFICE.

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APPARATUS FOR COMPACTING GRANULAR MATERIAL.

Application filed August 18, 1922. Serial No. 582,834.

This invention relates to apparatus for compacting granular material. More particularly it relates to the production, from granular cork, of compact sticks of a size suitable for cutting into cork discs for bottle closures.

Cork discs for bottle closures, such as the well known crown corks, have heretofore been obtained, according to one method, by cutting sticks of proper diameter from natural cork blocks and slicing these sticks into discs by machines designed for that purpose. Machines have also been devised for forming what may be termed artificial cork sticks, that is, sticks formed of granular cork, from which discs could be sliced. These machines include means for tamping a number of successive charges in a tubular holder until a relatively long stick is formed.

It has been found, however, that the machines referred to are subject to various objections. For example, they are uneconomical. This is due in part to a considerable loss of material from rejected sticks because of uneven compression, and also to a low output for a high labor cost. Furthermore, the long sticks produced are inconvenient in handling, in treating and in slicing.

It is the principal object of the present invention to provide apparatus for economically producing sticks of granular material, for example, cork, such that the product is even and uniform and the output high per unit apparatus.

With this general object in view the invention consists in the features, combinations, details of construction and arrangements of parts which will first be described in connection with the accompanying drawings and then more particularly pointed out.

In the drawings—

Fig. 1 is a view in side elevation with parts broken away and in section of a portion of an apparatus constructed in accordance with the invention;

Fig. 2 is a cross sectional view taken on the line 2—2 of Fig. 1;

Fig. 3 is an end view with parts broken away and in section, looking in the direction of the arrow 3 of Fig. 2;

Fig. 4 is a cross sectional view taken on the line 4—4 of Fig. 2;

Fig. 5 is a similar view taken on the broken line 5—5 of Fig. 3;

Fig. 6 is a similar view taken on the line 6—6 of Fig. 2;

Fig. 7 is a sectional view taken on the line 7—7 of Fig. 6;

Fig. 8 is a sectional view taken on the line 8—8 of Fig. 3;

Fig. 9 is a similar view taken on the line 9—9 of Fig. 8;

Fig. 10 is a sectional view taken on the line 10 of Fig. 5;

Fig. 11 is a similar view taken on the broken line 11—11 of Fig. 10;

Fig. 12 is a detail view showing in cross section a safety compensating device for the drum drive;

Fig. 13 is a detail view showing in cross section a safety slip connection for the plungers;

Fig. 14 is a detail view showing a portion of Fig. 6 with the parts in a different position;

Fig. 15 is a detail view showing in vertical section, the adjusting device shown in Fig. 3;

Fig. 16 is a detail view in section (enlarged) showing the gate closing mechanism indicated in Fig. 3;

Fig. 17 is a diagrammatic view illustrating the course of the cork; and

Fig. 18 is a perspective view of a completed stick.

In the apparatus hereinafter described and which forms an exemplification of the invention, granular cork, mixed with a suitable binder, is delivered to a hopper. Charges of a volume to give the desired stick are taken from the hopper by a measuring receiver of a length and cross section greater than the final product. The charge is compressed along its length to give it the desired cross section and is then compressed endwise, preferably by a single continuous stroke, to give it the desired length. The compressed sticks are confined in carrier molds and conveyed through a heating medium which causes a thorough permeation of

the binder and through a cooling medium which sets the sticks so that they retain their form upon removal from the carriers. The sticks may be then subjected to suitable treatment, such as exposure to the air, and

5 sliced into discs as desired.

In the following description the material is referred to as cork and the product as a stick. It is to be understood, however, that the invention is applicable to compacting other materials and that the word "stick" to define the product is used in a comprehensive sense.

Referring to the drawings, granular cork, previously mixed with a binder, is delivered to a hopper. As here shown as an example, there is provided a trough 18 (Fig. 17) which may lead from the mixing room. In this trough revolves a screw conveyor 19. Below the trough 18 is a hopper 20 in the form of a continuation of a vertical chute 21 leading from the trough 19. The material fed forward by the conveyor 19 falls into chute 21 and so into the hopper 20.

Means is provided for intermittently tapping the chute to shake down the cork. As here shown as an example, a tapper or hammer 22 (Fig. 3) is carried by a rod 23 pivotally connected with the chute and drawn toward the latter by a spring 24. The end of rod 23 is engaged by the arms of a star wheel 25 on a shaft 26, driven as later described. As the star wheel 25 rotates, the rod 23 is alternately swung away from the chute and permitted to return toward the latter by its spring. Upon each return movement the hammer 22 strikes the chute and this tapping serves to shake down the cork.

There is also provided means for agitating the cork near the bottom of the hopper. Although capable of various constructions, in that here illustrated as an example, extending across the hopper is a squared shaft 27 carrying stirrers 28 in the form of combs of the construction shown in Figs. 5 to 7. One end of the shaft 27 has a bevel gear 29 meshing with a similar gear 30 on the shaft 26. Shaft 26 is rotated by means of a sprocket 31 (Fig. 5), chain 32 and sprocket 33 which is, in turn, rotated by a main drive shaft 34 to which power may be applied in any suitable manner. The rotation of the comb stirrers 28 agitates the cork in the hopper, thus preventing lumping and aiding in the feed to the receiving means to be described.

There is provided means for acting on a charge of cork in two directions, thereby to compress the cork into its desired form. This may be accomplished, for example, by delivering to a receiver or mold element, a measured charge of material of a length and cross section greater than the desired product, compressing the charge along its length to give it the desired cross section, and com-

pressing it endwise to give it the desired length. While the receiver or mold element and the preliminary compressing means may vary in construction, in that here shown as an example, rotatably mounted at the bottom of the hopper 20 is a drum 35 having a plurality of spaced longitudinal mold grooves 36. The bottom of each groove is arcuate in form and the depth of the groove is substantially greater than the diameter of the circle of which such arc is a part. As is hereinafter more fully explained, the grooves 36 act as mold parts in determining the ultimate cross section of the cork sticks, the radius of the groove bottoms being governed by the diameter of the desired stick. The grooves are of a capacity to take a quantity of cork that will compress into a stick of the desired size. The apparatus illustrated is particularly adapted to the production of three inch sticks, approximately one inch in diameter. This diameter makes possible discs of a customary size and sticks of this length are suitable for slicing machines, for storing and for handling.

The side walls of the hopper extend downwardly at each end of the drum 35 and serve as end walls for the mold grooves 36 (Fig. 2). To serve as a cut off at the bottom of the hopper, there is provided an insert block 56 having an arcuate inner face to accommodate drum 35 (Fig. 6).

The drum 35 is intermittently rotated in the direction of the arrow in Fig. 6. To this end, as here shown as an example, the drum is mounted on a shaft 37 carrying a notched ratchet 38. This ratchet is given intermittent angular movement by means of a spring pressed pawl 39, pivoted to an arm 40 hung from shaft 37. Arm 40 is connected by a yoke 41 with a safety compensator (Fig. 12). This comprises a shouldered rod 42 passing through a collar 43. Between collar 43 and a yoke 44 is a spring 45 and pinned to yoke 44 is a sleeve 46 slidable on collar 43. Yoke 44 is pivoted to a coupling 47 connected, in turn, with a bent lever 48 having a cam roller 49 running in a cam groove in a cam element 50 on shaft 34. The other end of lever 48 is fulcrumed on the end of an arm 51 pivoted between its ends on a stud 52, its other end being slidable on a rod 53 and adjustably held in position by nuts 54. As the cam element 50 rotates, lever 48 oscillates on its pivot and actuates, through the connections described, the pawl 39. As the yoke 47 is pushed upwardly, its force is transmitted through the spring 45 to collar 43 and thence to rod 42, the compensator parts normally moving as a unit. Should the pawl encounter an excess opposing force it can yield, spring 45 being compressed and sleeve 46 sliding on collar 43. Normally, however, the ratchet is notched ahead one step for each oscilla-

tion of lever 48, thus stepping ahead the mold drum. By adjusting the position of the end of arm 51 on rod 53, the fulcrum of lever 48 can be shifted to adjust the stroke of the pawl.

In order to assure accurate positioning of the drum grooves, means is provided for locking ratchet 38. To this end, as here shown as an example, above the ratchet is a spring pressed block 55 adapted to enter the ratchet notches. To withdraw block 55 the arm 40 has a wiper 55^a which wipes against block 55 to force the same out of a notch as the pawl is drawn back. On the forward stroke of arm 40 and pawl 39, the block is free to drop into a notch and lock the ratchet at the end of its stroke, thus accurately positioning the drum for the operations of the compressing elements to be described.

As a groove 36 moves up past block 56, it moves against the mass of cork and receives its charge. Continued movement of the groove brings it beneath a pointed scraper 57, beyond which it passes under curved cut off plates 58, 59 formed by an insert piece and part of the hopper housing (Fig. 6). The scraper serves to scrape off excess cork down to the level of the drum and the measured charge received by the groove is held therein by the cut-off plates as the groove moves on to the compressing station.

At this station, and during a pause in the movement of the drum, the measured charge is compressed along its length to compact it to the desired cross section. To this end, in the present embodiment, the cut off plate 59 terminates in plate 60 extending outwardly from the cylinder. Below this plate 60 and parallel thereto is a second plate 61. These two plates form a guide channel in which is slidable a compressing plunger 62. The plunger 62 is of a width equal to the length of grooves 36 (Fig. 2) and has a concave front edge formed to correspond to the radius of the groove bottoms (Figs. 6 and 14). In thickness the plunger 62 has a running fit in grooves 36. When the plunger is advanced into a groove by means to be described, it compresses the charge of material along the length thereof, forcing it down into the bottom of the groove, until the groove bottom and the plunger-edge form, in effect, a cylindrical mold in which the charge is compacted to the desired diameter (Fig. 14), the length as yet remaining unchanged.

While the means for operating plunger 62 may vary, it may advantageously provide for a cushioned compressing stroke. Although capable of various constructions, in that here shown as an example, connected with the plunger 62 is a fluid-pressure cylinder 63 in which is slidable a piston 64. Opening into the front end of this cylinder

is a pipe 65 leading to a suitable source of compressed air or the like, not shown. The piston 64 has a rearward piston rod 66 pivotally connected with a lever 67 fulcrumed at 68. The opposite arm of lever 67 carries a roller 69 running in a cam groove 70 formed in a cam element 71 rotated by shaft 34. When, by rotation of the cam element 71, lever 67 is operated to move the piston 64 inwardly, at first the compressed air in front of the piston transfers the force to the cylinder and cylinder and plunger move inwardly together; piston 64 having no movement relative to the cylinder. When, however, the plunger 62 encounters increased resistance, the piston can move forward against the air pressure, thus cushioning the stroke. Upon the return stroke of lever 67, the cylinder is caused to return with it, thus withdrawing the plunger from the groove 36.

With the plunger 62 advanced into a mold groove 36, plunger and groove constitute a container for holding a charge of material of a greater length than the final stick. In the particular embodiment shown, the volume of this charge is such as to permit compression to final length by a single endwise compressing action. There is provided means for compressing the contained charge and in structures embodying the invention to what is now considered the best advantage, the charge is compressed by the stroke of a ram which transfers the charge to a carrier mold later referred to, an abutment being provided at the far side of the carrier mold. While the ram may be actuated in various ways it may advantageously be advanced by a fluid pressure unit. Although capable of various constructions, in that here shown as an example, in line with the container formed by a groove 36 and plunger 62 and movable therewith is a ram 72. The end plates embracing the drum 35 have suitably aligned holes for the passage of this ram (Fig. 2). The ram 72 is mounted on the end of a fluid pressure cylinder 73 in which is a stationary piston 74. Extending through the piston 74 and opening into the forward end of the cylinder is a passage 75 connecting with a bore 76 in a bracket 77 to which the piston is secured. The bore 76 connects with a pipe 78 leading from a valve chamber to be described.

When fluid under pressure, such as compressed air, is admitted to pipe 78, as later described, it passes through bore 76 and through a check valve 79 mounted in a thimble 80 (Fig. 9) into passage 75, thereby causing cylinder 73 and ram 72 to be advanced, the action of the ram on the charge being later described.

Means is provided for automatically controlling admission of air to the cylinder thereby to time the stroke of the ram. In

the exemplification illustrated, a pipe 81 leading from a suitable source of pressure fluid supply, such as air (not shown) opens into a valve chamber 82, pipe 78, above referred to, opening into a bore 83 in the end wall of this chamber. Rotating in the valve chamber is a valve disc 84 mounted on a shaft 85 rotated by a gear 86 meshing with a gear 87 driven by the main shaft 34. The valve disc 84 has an opening 83' located to register with the end of bore 83 as the valve rotates. During this period of registry the compressed air in the valve chamber can pass to pipe 78, the supply to this pipe being at other times cut off. For each rotation of the valve disc, therefore, the ram 72 is advanced as above described.

The ram 72 and cylinder 73 are, in the present embodiment, returned by mechanical means to be described. To permit the compressed air in the cylinder to exhaust, as here shown as an example, in the end wall of the valve chamber 82 is a passage 88 leading to an exhaust pipe 89. In that face of the valve disc 84, that is away from the intake pipe 81, is a recess 90 dimensioned to span passage 88 and bore 83, thus connecting pipe 78 with exhaust pipe 89. During the period of this connection the air in pipe 78 back of thimble 80 exhausts via pipe 89. This permits thimble 80 to be moved endwise in its seat by the force of the air in cylinder 73, whereby passage 75 is placed in communication with a bore 91 formed in the end of the piston and leading, through an adjustable throttle valve 92, to atmosphere. When this movement of thimble 80 takes place, the air in the cylinder exhausts through valve 92.

While the means for withdrawing ram 72 may vary, in the present embodiment, on the cylinder 73 is a strap 93 having trunnions 94 in which are mounted blocks 95 slidable in yokes 96 formed on the ends of levers 97 fulcrumed on stud 52. The levers 97 are pinned to parallel arms 98 pivoted to links 99 mounted on a stud 100. One of the arms 98 carries a cam roller 101 running on a cam 102 rotated by the main shaft 34. This cam is laid out to permit forward movement of the ram under air pressure and to cause return movement through the connections just described.

Means is provided for cushioning the advancing stroke of the ram. As here shown as an example, mounted on the ends of trunnions 94 are connecting rods 103 secured to a cross head 104. This cross head carries a piston 105 movable into a cylinder 106, secured to bracket 77, the cylinder 106 having slots for a portion of its length to accommodate the cross head. Opening out of the end of cylinder 106, in the bracket 77, is a bore 107 communicating with an adjustable throttle exhaust valve 108. As the

ram 72 and cylinder 73 are moved forward, piston 105 is moved into cylinder 106. This compresses the air trapped in the end of cylinder 106, which air can escape only through throttle valve 108, thus cushioning the stroke of the ram. As here shown, the ends of bolts 109 which secure the cylinder 106 to bracket 77 serve as safety stops in line with cross head 104.

When ram 72 is advanced it passes through the container, pushing ahead of it the charge of material which is thus transferred to and compressed in a waiting carrier mold now to be described.

The invention in its entirety includes a conveyor chain having a plurality of carrier molds and means for intermittently alining a carrier mold with the container and ram 72. Although the conveyor chain and its positioning means may vary in construction, in the present embodiment, there is provided an endless conveyor chain of which each link comprises two cylinders 110 mounted in plates 111. Within each cylinder is an open ended carrier mold 112 of the shape and size of the desired stick. Each cylinder 110 of a given link is connected to the adjacent cylinder of the next link by means of a double-eye coupling 113, the eyes of which embrace the cylinders to pivot thereon. Secured to each plate 111, but spaced therefrom is a side plate 114 having openings in alinement with the ends of the cylinders 110. There is provided means for confining the charges received by the molds 112. This may be conveniently accomplished by means of shutters for closing the ends of the mold cylinders. To this end, as here shown as an example, for each mold, slidable between the side plate 114 and the plate 111 across each end of the mold is a shutter or gate 115. Each shutter has an off-center opening to register with the end of the mold when the shutter is moved to a given "open" position. When moved to the opposite position, the shutter presents an end closure for the mold to confine the charge. Fig. 3 shows both shutters closed and Fig. 4 shows both shutters open. The shutters are freely slidable in their mountings and are prevented from falling out by means of stop shoulders 116 with which each shutter is provided. The shutters are operated and held open or closed as later described.

During that portion of the travel of the chain in which it passes the apparatus above described, the chain runs on rails 117 so as to have a proper vertical position with relation to the container and ram. The carrier molds are successively alined with the container and ram by an intermittent chain-drive to be described. Assuming that a carrier mold is in position and that its inner shutter is open, upon advance of the ram

72 the charge of material is pushed from the container into the carrier mold. While the abutment before mentioned, which co-operates with the ram to cause endwise compression of the charge, may be of various constructions, in the present embodiment, the outer shutter, backed by a part of the frame, serves as an abutment. To cause the outer shutters to be in closed position, there is provided, as here shown as an example, a cam track 118 against which the outer shutters ride as they approach the loading station and which forces them down into closed position.

The forward stroke of ram 72, therefore, transfers the charge from the drum to the carrier mold and by the same single stroke compresses it endwise into its final length. With a ram operated as described, a rapid movement is possible and the compressive effect is uniform throughout the length of the cork stick.

Means is provided for closing the inner gate 115 as the ram 72 is withdrawn so as to confine the charge. Although capable of various constructions, in that here illustrated as an example, above the inner shutters when at the loading station, is a push block 119 (Fig. 16) mounted on the piston rod 120 of a piston 121 working in a cylinder 122. This cylinder is connected by a port 123 with a valve chest 124 in which is slidable a valve 125 and which communicates with a pipe 126 leading to a suitable source of compressed air or the like, not shown. Valve 125 is normally held by a spring 127 in a position to cut off port 123 from the air supply. To shift the valve to the position of Fig. 16, the valve rod 128 is actuated by a block 129 (Fig. 3) on the end of a bell crank lever 130, the second arm of which has a cam roller 131 (Fig. 5) riding on a cam 132 on the main shaft 34. When the valve 125 is thus operated, pressure fluid is admitted to cylinder 122 and the piston 121 is forced down, thus pushing down the shutter to closed position. With fluid pressure actuation and a properly timed cam, the closing of the shutter is almost instantaneous and the compressed stick has no time to re-expand upon withdrawal of the ram. Once the shutters are closed, the tendency of the compressed stick to reexpand is found sufficient to hold the shutters in closed position. As the cam 132 rotates, it permits spring 127 to close valve 125, thus cutting off the pressure fluid. Block 119 and piston 121 are then returned to former position. This is effected, as here shown, by means of a spring 134 acting on a rod 133 (Fig. 1) pivoted to the hopper housing and secured to block 119.

After the ram has withdrawn and the shutter closed, the loaded carrier mold is advanced and the next empty one brought

up to loading position. While the intermittent chain driving means may vary in construction, as here illustrated, at the ends of the chain supporting rails are large sprockets 135, 136 over which the chain passes. Sprocket 135 is mounted on a stud 137 having a bevel gear 138 meshing with a similar gear 139 on a cross shaft 140. This shaft has a bevel gear 141 meshing with a similar gear 142 on a stud 143 on which is mounted the other sprocket 136. With the construction described, one sprocket is driven from the other.

To drive the sprockets, in the embodiment shown, on the interior of sprocket 136 is a ratchet 144. Cooperating with this ratchet is a spring pressed pawl 145 mounted on a pawl carrier 146. This carrier is mounted on a pivotally hung arm 147 and has a link 148 pivoted to one arm of an actuating lever 149, fulcrumed on a stud 150 mounted as later described. The other end of lever 149 has a cam roller 151 running in the groove of a cam 152 mounted on the main shaft 34. As the shaft 34 rotates, the sprockets 135, 136, through the connections described, are intermittently rotated to move the carrier molds, step by step, past the filling station.

In order that the intermittent chain movement may be accurately timed, means is provided for adjusting the position of stud 150. Although capable of various constructions, in that here shown as an example, stud 150 is mounted at its inner end in a pivotally hung arm 153 clamped between two stop screws 154 (Figs. 3 and 15). The outer end of stud 150 is suspended between a cradle block 155 carried on a shouldered frame support 156 (Fig. 3) and a clamping block 157. The latter is adjustably connected by bolts 158 with the shoulders of support 156. Stud 150 may be raised by shimming up block 155, bolts 158 and screws 154 being adjusted accordingly. Or it may be lowered by removing shims or substituting different sized blocks for block 155.

The invention in its entirety includes means for providing a heating medium whereby the confined charges may be heat treated. While the heating effect may be accomplished in various ways, it may be done by means of a tank of hot water through which the carrier molds travel. As shown as an example in Fig. 17, which illustrates suitable heating means more or less diagrammatically, beyond the compressing and loading apparatus is a tank 159 containing hot water, supplied through pipes 160 and pump 161, from a source of supply 162, a pipe 163 leading back to the source of supply. This water may suitably be maintained at a temperature of from 200 to 210° F. In order to keep the molded sticks in

this hot water tank for a considerable space of time the conveyor chain is doubled back and forth as many times as may be necessary, running over suitable pulleys, indicated at 164. The heating effect of the hot water in this tank causes the binder, with which the granular cork was mixed, to thoroughly permeate the particles of cork.

There is provided means for subjecting the heated charges to a cooling action and this may be conveniently accomplished by means of water. In the present exemplification, the molds travel through a tank of cooling water. To this end, as here illustrated, after the carrier molds leave the heating tank they pass into an intermediate tank 165 connected with a source of supply 166 of water which may suitably be at a temperature of approximately 100°. The molds are kept in this tank about one-quarter of the time they remain in the hot tank, the chain doubling back and forth as shown in Fig. 17. This intermediate tank makes possible an easy step down from the hot condition, thereby avoiding excessive refrigeration.

From the intermediate tank the chain carries the molds into a cooling tank 167 in which water at about 65° F. is delivered by suitable connections from a source of supply 168. As in the hot tank, the chain is doubled back and forth to permit the molds to remain in the cooling medium a considerable time. The cooling of the compressed and heat treated stick sets the stick so that it will not reexpand out of shape after its release from the carrier mold.

It will be understood that any suitable refrigerating apparatus may be used to keep the cold water at the desired temperature and any suitable heating apparatus may be used to heat the hot water.

From the cooling tank, in the present embodiment, the chain leads back underneath the various tanks to a position where the carrier molds again approach the compressing and loading apparatus. In order to avoid starting and stopping the entire chain, for each positioning of a mold at the loading station, there is provided means for driving the greater part of the chain continuously. This may be accomplished by providing a chain of sufficient length to have a certain amount of slack beyond the sprocket 136. The main portion of the chain may be continuously driven, for example, by applying power to one or more of the several pulleys 164. This main driving means draws the chain from sprocket 136, through the tanks, and back to a point where it is taken by sprocket 135. During the periods when the chain is at rest at the loading station, the slack beyond pulley 136 compensates for the differential movement.

Means is provided for opening the shut-

ters and ejecting the cork sticks before the carrier molds reach filling position. Although capable of various constructions, in that here shown as an example, near the top of the sprocket 135 are two cam tracks 170, 171 up which the shutters ride, whereby they are forced upward to open position. During the one of the periods of rest of the chain, while a previous mold is receiving a new charge, a subsequent mold is positioned in alinement with an ejector ram 172. This ram has a hub mounted on a pin 173 on which is also the hub of a yoke 174 connected as later described by a link 175 with the yoked end of a lever 176. This lever is fulcrumed at 177 and is pivoted intermediate its ends (Fig. 4) to a slotted slide 178 working on a block 179 and carrying oppositely disposed cam rollers 180, 181 running on a cam 182 on shaft 34. By the advance of the ejecting ram the cork sticks are ejected into a chute 183, which may direct them to suitable conveyors or receptacles as desired.

There is provided means for lubricating the empty molds before they receive a new charge. This may conveniently be accomplished by a swabbing plunger operating with the ejecting ram. As here shown as an example, mounted on pin 173 is the hub of a swabbing plunger 184 spaced from the ejecting plunger the distance of one chain step. After a given carrier mold has had its charge ejected, the next step forward of the chain aligns that mold with the lubricating plunger. It is to be understood that a lubricant may be applied to the swabbing end of plunger 184 in any suitable manner.

In order that the ejecting and lubricating plungers may yield upon encountering an undue obstruction, the link 175, as here shown, has a slip connection with lever 176. To this end, carried by the yoked end of lever 176 is a housing 185 containing a spring 186 adjustably held therein by a screw 187. The link 175 passes through the housing 185 and is notched to receive a projection on a block 188 forced into the notch by spring 186. Normally the force of the spring is sufficient to maintain link 175 and lever 176 connected to operate together. But in case either the ejecting plunger or the lubricating plunger encounters excessive resistance, link 175 can slip and so permit the plungers to yield.

As a carrier mold leaves the lubricating station, the outer shutter is closed, to be ready to receive the new charge, by the overhanging cam track 118 which extends past the filling station. The inner shutter, however, remains open. As this shutter is to be closed immediately upon withdrawal of the loading ram, its opening cam track 170 terminates short of the filling station. There is provided means for preventing closing of the inner shutter by gravity while in load-

ing position. To this end, in the present embodiment, below the inner shutters when at the filling station is the end of a pivoted lever 190 swung upwardly by a spring 191 (Fig. 1). This spring has sufficient force to hold the lever up and keep the shutter open under normal conditions. It yields, however, to permit the shutter to be closed upon operation of piston 121 as above described.

As indicated in Fig. 17, one set of tanks can accommodate a plurality of compressing and conveying units. By suitably staggering these units, the several chains can pass through the tanks side by side and close together, additional guide pulleys being provided as required. In this manner, the increased output of duplicated compressing apparatus is obtained without duplication of the heating tanks. Further, any unit can be cut out regardless of the other units, when desired.

The operation of the apparatus shown will be clear from the foregoing description. To summarize, however, the material being fed to the hopper, a drum groove 36 receives a measured charge and carries it to the compressing and loading station. Here, during an interval between movements of the drum, plunger 62 is advanced to compress the charge along its length, into the desired cross section. While this plunger is in advanced position, ram 72 moves forward to transfer the charge into a waiting carrier mold 112 and compress it endwise against the outer shutter 115, which was previously closed by cam track 118. The stroke of the ram compresses the charge into the desired length, i. e., a length to fit the carrier mold. Ram 72 is then withdrawn and the inner gate is immediately closed by the push block 119, thereby confining the charge in the mold.

During this interval in the movement of the chain, a succeeding carrier mold is being lubricated and the one succeeding that is positioned in alinement with the ejecting ram 172 which ejects the completed stick. Prior to reaching the ejecting stations, the shutters have been opened by cam tracks 170, 171.

Following withdrawal of the loading ram, the lubricating plunger, the ejecting ram, and the compressing plunger, the drum is advanced one step to bring the next groove to the compressing station and the chain is advanced one step to position the next carrier mold to receive its charge.

The filled carrier molds are successively conveyed by the chain, from the loading station through the heating and cooling tanks and back to the ejecting station.

For each cycle of the apparatus, therefore, a measured charge of material is received, compressed along its length, transferred to the carrier mold and compressed endwise; a

completed stick is ejected; and an empty carrier mold is lubricated. During each cycle, the filled molds beyond the loading station are moving continuously to, through and from the heating tanks, the slack in the chain compensating for this differential chain movement.

It will be noted that the receiving drum, the compressing plunger, the compressing and transferring ram, the intermittent chain drive, the inner gate closer, the ejector ram, and the lubricating plunger are all actuated or controlled from the main drive shaft 34, in most instances by means of cams. With this construction, aided, when necessary by the adjustment features above described, the movements of the cooperating parts can be properly and accurately timed.

What is claimed is:

1. In apparatus of the class described, and in combination, a receiver for taking a measured charge of material, means for compressing the charge along its length to give it a desired cross section, a carrier mold, means for compressing the charge endwise to give it a desired length and transferring it from the receiver to the carrier mold, and means for confining the compressed charge in the carrier mold.

2. In apparatus of the class described, and in combination, a carrier mold corresponding in size and shape to the desired product, a mold element having a groove for taking a measured charge of material, a plunger movable into said groove along the length thereof to compress the charge to a cross section corresponding to that of the carrier mold, means for transferring the charge from the groove to the carrier mold and compressing it endwise therein comprising a ram having substantially the cross section of the carrier mold, and means for confining the compressed charge in the carrier mold.

3. In apparatus of the class described, and in combination, an endless conveyor, means for providing heating and cooling mediums adjacent part of the path of the conveyor, a plurality of carrier molds carried by the conveyor, means including a loading ram for compressing charges of material and inserting them in the molds, means for moving the conveyor to position successor molds opposite said ram, and means for confining the charges in the molds.

4. In apparatus of the class described, and in combination, a hopper for containing a mass of material, a drum having a plurality of mold grooves for receiving charges of material from said hopper, means for giving said drum an intermittent rotation whereby the grooves are successively moved past the material in the hopper, a plunger movable into a groove along the length thereof for compressing the charge

into a desired cross section, means for operating said plunger during a period of rest of the drum, a carrier mold, an abutment at the far side of said carrier mold, a ram
 5 for acting on the charge to transfer it from the groove to the carrier mold and at the same time compress it endwise to give it the desired length, and fluid pressure means for operating the ram during said period of
 10 rest of the drum.

5. In apparatus of the class described, and in combination, a hopper for containing a mass of material, a drum having a plurality of mold grooves for receiving charges
 15 of material from said hopper, means for giving said drum an intermittent rotation whereby the grooves are successively moved past the material in the hopper, a plunger movable into a groove along the length
 20 thereof for compressing the charge into a desired cross section, means for operating said plunger during a period of rest of the drum, a conveyor chain, a plurality of carrier molds conveyed thereby, means for operating
 25 said chain to position intermittently a carrier mold in alinement with the compressed charge, a ram movable through the drum grooves for transferring the charge to the positioned carrier mold, and means
 30 for operating said ram during said period of rest of the drum.

6. In apparatus of the class described, and in combination, a hopper for containing a mass of material, a drum at the bottom of
 35 said hopper and having a plurality of mold grooves for receiving charges of material, means for giving the drum an intermittent rotation, a plunger movable into a groove to compress the charge to a desired cross section,
 40 a cam element for causing operation of said plunger, a lever operated by said cam element, and a cylinder and piston connection between the lever and plunger, the cylinder having communication with a
 45 source of fluid under pressure, whereby the plunger is operated with a yieldable stroke.

7. In apparatus of the class described, and in combination, a plurality of carrier molds, a container means for holding a
 50 charge of material of a cross section corresponding with the cross section of said molds and of a length longer than the latter, a ram for transferring the charge from the container means to a mold and compressing it
 55 endwise therein, means for confining the charge in the mold, means for providing a heating medium for heat-treating the charges, and conveyor means for moving the carrier molds to and through said heating
 60 medium.

8. In apparatus of the class described, and in combination, a conveyor, a plurality of carrier molds conveyed thereby, a container
 65 for holding a charge of material of a diameter to fit said molds, means for moving

the conveyor to position a carrier mold in alinement with the container, a ram for transferring a charge of material from the container to a carrier mold, means for reciprocating the ram, shutters for the entrance ends of the carrier molds, and shutter
 70 closing means operable to close the shutter following the transfer of a charge to the carrier mold.

9. In apparatus of the class described, and in combination, a conveyor, a plurality of carrier molds conveyed thereby, a container for holding a charge of material of
 75 a diameter to fit said molds, means for moving the conveyor to position a carrier mold in alinement with the container, a ram for transferring a charge of material from the container to a carrier mold, means for reciprocating the ram, shutters for the entrance ends of the carrier molds, and fluid-
 80 pressure means for closing said shutters.

10. In apparatus of the class described, and in combination, a conveyor, a plurality of carrier molds conveyed thereby, a container for holding a charge of material of
 85 a diameter to fit said molds, means for moving the conveyor to position a carrier mold in alinement with the container, a ram for transferring a charge of material from the container to a carrier mold, means for reciprocating the ram, shutters for the entrance ends of the carrier molds, a shutter closer including a fluid pressure unit, a valve for controlling the admission of pressure fluid to said unit, and means for operating
 90 said valve.

11. In apparatus of the class described, and in combination, a conveyor, a plurality of carrier molds conveyed thereby, a container for holding a charge of material of a
 95 diameter to fit said molds, means for moving the conveyor to position a carrier mold in alinement with the container, a ram for transferring a charge of material from the container to a carrier mold, a drive shaft, means controlled by the rotation of said drive shaft for reciprocating said ram, shutters for the entrance ends of the carrier molds, a shutter closer including a fluid pressure unit, a valve for controlling the admission of pressure fluid to said unit, and means controlled by said drive shaft for operating
 100 said valve.

12. In apparatus of the class described, and in combination, a conveyor, a plurality of carrier molds conveyed thereby, a container for holding a charge of material, means for moving the conveyor to position a carrier mold
 105 in alinement with the container, a ram for transferring the charge from the container to a carrier mold, shutters for the ends of the carrier molds, a shutter closer for closing the outer shutter of a mold before the operation of the ram, a shutter opener for opening the inner shutter before the opera-
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tion of the ram, and a shutter closer for closing the inner shutter following the transfer stroke of the ram.

13. In apparatus of the class described, and in combination, a conveyor, a plurality of carrier molds conveyed thereby, a container for holding a charge of material of a diameter to fit said molds, means for moving the conveyor to position a carrier mold in alinement with the container, a ram for transferring a charge of material from the container to a carrier mold, a shutter for the inner end of the carrier mold, a yieldable shutter-engaging element for holding the shutter open for the reception of the charge, and a shutter closer for closing the shutter following the transfer stroke of the ram.

14. In apparatus of the class described, and in combination, a conveyor chain, a plurality of carrier molds conveyed thereby, sprockets over which said chain passes, means for giving said sprockets an intermittent movement, a loading ram for feeding a charge to a carrier mold, means for providing a heating medium, through which heating medium the filled molds are conveyed, shutters for the carrier molds, cam elements for opening said shutters after the molds leave the heating medium, a charge ejecting ram beyond the shutter opening elements, and shutter closing means.

15. In apparatus of the class described, and in combination, a conveyor chain, a plurality of carrier molds conveyed thereby, sprockets over which said chain passes, means for giving said sprockets an intermittent movement, a loading ram for feeding a charge to a carrier mold, means for providing a heating medium, through which heating medium the filled molds are conveyed, shutters for the carrier molds, cam elements for opening said shutters after the molds leave the heating medium, a charge ejecting ram beyond the shutter opening elements, a shutter closing cam for the outer shutter located between the ejecting ram and the loading ram, a shutter closer for the inner shutter, and means for operating said last named shutter closer following the loading stroke of the loading ram.

16. In apparatus of the class described, and in combination, a conveyor chain, a plurality of carrier molds conveyed thereby, sprockets over which said chain passes, means for giving said sprockets an intermittent movement, a loading ram for feeding a charge to a carrier mold, means for providing a heating medium, through which heating medium the filled molds are conveyed, shutters for the carrier molds, cam elements for opening said shutters after the molds leave the heating medium, an ejecting ram beyond the shutter opening cams, a lubricating ram between the ejecting ram and the loading ram, and means for simultaneously

operating said rams during one period of rest of the conveyor chain.

17. In apparatus of the class described, and in combination, a conveyor chain, a plurality of carrier molds conveyed thereby, a loading ram for loading a charge into said molds, means for providing a heating medium through which heating medium the conveyor chain passes, means for giving the chain a step by step movement past the loading ram, and means for giving the chain a continuous movement through the heating medium and back to a point adjacent the loading ram, a slack in the chain serving to compensate for the differential movement.

18. In apparatus of the class described, and in combination, a conveyor chain, a plurality of carrier molds conveyed thereby, a loading ram for loading a charge into said molds, a heating tank through which the molds are conveyed, a sprocket on either side of the loading station over which the chain passes, guide pulleys for guiding the chain from the second sprocket to and through the tank and back to the first sprocket, a driving connection between said sprockets, a pawl and ratchet drive for one of said sprockets to give the chain an intermittent movement past the loading station, and means located beyond the sprockets for giving the chain a continuous movement, a slack in the chain beyond the sprockets serving to compensate for the differential movement.

19. In apparatus of the class described, and in combination, an endless conveyor, a plurality of carrier molds conveyed thereby, a heating tank through which the conveyor conveys the carrier molds, a container for holding a charge of material of a diameter to correspond to the diameter of the carrier molds, means for positioning a carrier mold in alinement with said container, and means for transferring the charge from the container to the carrier mold.

20. In apparatus of the class described, and in combination, an endless conveyor, a plurality of carrier molds conveyed thereby, means for providing a heating medium through which medium the conveyor conveys the carrier molds, a container for holding a charge of material of a diameter to correspond to the diameter of the carrier molds, means for positioning a carrier mold in alinement with said container, a ram for acting on the charge endwise thereof to transfer the charge to the carrier mold, and an abutment at the far side of the carrier mold whereby the charge is compressed by said ram.

21. In apparatus of the class described, and in combination, an endless conveyor, a plurality of carrier molds conveyed thereby, means for providing a heating medium through which medium the conveyor conveys the carrier molds, a container for holding a

charge of material of a diameter to correspond to the diameter of the carrier molds, means for positioning a carrier mold in alinement with said container, and means, including a ram, for transferring said charge to the carrier mold and compressing it endwise by a single, continuous stroke of said ram.

22. In a mold conveyor chain, oppositely disposed plates, an open-ended cylinder mounted between said plates, an eye-bar pivotally mounted on said cylinder for connection with a like cylinder in another link, and a mold element within said cylinder.

23. In a mold conveyor chain, oppositely disposed inner plates, a mold carried between said plates, side plates secured to said inner plates, spaced therefrom, and having openings in alinement with the mold, and shutters slidably mounted between the side plates and inner plates and having openings positioned to be brought in and out of registry with the mold by movement of the shutter.

24. In a mold conveyor chain, oppositely disposed inner plates, a plurality of cylinders mounted therebetween, side plates spaced from the inner plates and having openings alining with the cylinders, mold elements within the cylinders, shutters slidably mounted between the side plates and inner plates, and eye bars pivotally mounted on the end cylinders for connection with cylinders of adjoining links.

25. In apparatus of the class described, and in combination, a conveyor chain comprising links having inner plates, a mold element therebetween, outer plates spaced from the inner plates, and shutters slidably mounted between the inner plates and side plates and having openings positioned to be brought into and out of registry with the mold element by movement of the shutter, track members for supporting the chain in its movement past ejecting and loading stations, cam tracks for opening the shutters before reaching the ejecting station, and means for closing the shutters.

26. In apparatus of the class described, and in combination, a receiver for holding a charge of material, a ram movable there-through, means including a fluid pressure unit for advancing said ram, a cross head connected with the moving element of the fluid pressure unit, a piston carried by the cross head, and an open ended cylinder into which the piston is moved, thereby to cushion the stroke of the ram.

27. In apparatus of the class described, and in combination, a receiver for holding a charge of material, a ram movable there-through, a fluid pressure unit including a stationary piston and movable cylinder to which the ram is secured, a lever device pivotally connected with the cylinder, a drive

shaft, a timing valve for controlling admission of pressure fluid to the cylinder operated from said drive shaft, and a cam on said drive shaft for actuating said lever means to withdraw the ram.

28. In apparatus of the class described, and in combination, a drum having a plurality of mold grooves, a pawl and ratchet drive for said drum, a compressing plunger movable into said grooves along the length thereof, a ram movable into said grooves endwise thereof, a drive shaft, means including a cam on said shaft for operating said plunger, a fluid pressure unit for advancing the ram and including a cylinder and piston to one of which elements said ram is secured, a valve chest having communication with a source of fluid under pressure, a conduit leading from the valve chest to said cylinder, a timing-valve in said valve chest and a valve operating connection between the valve means and the drive shaft.

29. In apparatus of the class described, and in combination, a rotatable drum having a plurality of mold grooves for receiving charges of material, a plunger for entering said grooves along the length thereof, a ram movable endwise through the grooves, a conveyor chain, a plurality of carrier molds conveyed thereby, shutters for the carrier molds, a shutter closer, a drive shaft, and means actuated or controlled by said drive shaft for rotating said drum, reciprocating said plunger and ram, advancing said conveyor chain, and operating said shutter closer.

30. In apparatus of the class described, and in combination, a drum having a plurality of mold grooves, a housing forming a hopper above the drum and end plates therefor, a ratchet and pawl driving means for the drum, parallel plates forming a guide, a cut off plate between the hopper and the guide, a compressing plunger reciprocable in said guide for entering a groove along the length thereof, means for advancing said plunger between strokes of the pawl, a ram movable endwise through the groove, and means for advancing said ram while the plunger is in advanced position.

31. In apparatus of the class described, and in combination, a conveyor chain, a plurality of carrier molds conveyed thereby, a loading ram, a sprocket wheel over which said chain passes, a ratchet connected with said sprocket to rotate the latter, a pawl for driving the ratchet, a pawl carrier, a rocker lever for operating the pawl carrier, a shaft on which said rocker lever is mounted, an adjustable suspension for said shaft, and means for rocking the rocker lever.

32. In apparatus of the class described, and in combination, a receiver for taking a measured charge of material, means for giving the charge two compressions at right

angles to each other, means for confining the compressed charge, a heating tank, and means for conveying the charge while confined through said tank.

5 33. In apparatus of the class described, and in combination, a receiver for taking a measured charge of material, means for compressing the charge along its length to give it a desired cross section, a carrier mold, means for compressing the charge endwise to give it the desired length and transferring it to the carrier mold, and shutters movable across the ends of the mold for confining the charge therein.

15 34. In apparatus of the class described, and in combination, a plurality of carrier molds, an endless conveyor in which said molds are mounted, a ram for inserting charges of material in said molds, shutters for the inner ends of said molds, and means for closing said shutters following the reception of the charge.

25 35. In apparatus of the class described, and in combination, a plurality of carrier molds, an endless conveyor in which said molds are mounted, a ram for inserting compressed charges of material in the molds, spaced plates associated with said molds, shutters freely slidable across the ends of the molds between said plates, and means for closing said shutters to confine the charges, the shutters being held closed by the expansive tendency of the charges.

35 36. In apparatus of the class described, and in combination, a plurality of carrier molds, an endless conveyor in which said molds are mounted, a ram for inserting charges in said molds, means for providing heating and cooling mediums through which mediums the conveyor carries the molds, slidable shutters for the ends of the respective molds, means for causing the shutter at the entrance end of a mold to be open and the other shutter closed when such mold is in charge-receiving position with respect to the ram, means for closing the shutter at the entrance end following the reception of a charge, and means for opening both shutters following the cooling treatment, thereby to permit ejection of the charge.

40 37. In apparatus of the class described, and in combination, a plurality of carrier molds, container means for holding a charge of material of a cross section corresponding with the cross section of said molds and of a length longer than the latter, a ram for transferring a charge from the container means to a mold and compressing it endwise therein, means for confining such charge in the mold, means for providing a heating medium and a cooling medium, and conveyor means for moving the carrier molds to and through the heating medium and then the cooling medium.

65 38. In apparatus of the class described, and

in combination, a conveyor chain, a plurality of carrier molds conveyed thereby, a loading ram for loading a charge into said molds, a sprocket on either side of the loading station over which the chain passes, means for guiding the chain from the second sprocket to a distant point and back to the first sprocket, means for providing a heating medium through which medium the molds are passed in the travel of the chain from the second to the first sprocket, a driving connection between said sprockets, a pawl and ratchet drive for one of said sprockets to give the chain an intermittent movement past the loading station, and means located beyond the sprockets for giving the chain a continuous movement, a slack in the chain beyond the sprockets serving to compensate for the differential movement.

39. In apparatus of the class described, and in combination, an endless conveyor, a plurality of carrier molds conveyed thereby, means for supplying a heating medium and a cooling medium to the action of which the molds are subjected by the travel of the conveyor, a container for holding a charge of material of a diameter to correspond to the diameter of the carrier molds, means for positioning a carrier mold in alinement with said container, and means for transferring the charge from the container to the carrier mold.

40. In apparatus of the class described, and in combination, a receiver for taking a measured charge of material, a carrier mold, means for giving the charge two compressions at right angles to each other and transferring it to the carrier mold, means for confining the compressed charge, means for providing a heating medium, and means for conveying the charge while confined through said heating medium.

41. In apparatus of the class described, and in combination, a conveyor, a plurality of open ended carrier molds carried thereby, shutters movably mounted at the ends of said molds, and operating means for closing and opening said shutters.

42. In apparatus of the class described, and in combination, a conveyor, a plurality of open ended carrier molds carried thereby, and shutters slidable across the ends of said molds.

43. In apparatus of the class described, and in combination, a conveyor, a plurality of open ended carrier molds carried thereby, a reciprocating charge-inserting ram, shutters mounted at the ends of the molds and movable into open or closed position, and means operated in timed relation with said ram for closing the shutter of a mold upon withdrawal of the ram.

44. In apparatus of the class described, and in combination, a conveyor, a plurality of open ended carrier molds carried thereby,

a reciprocating charge-inserting ram, shutters mounted at the ends of the molds and movable into open or closed position, and fluid operated means operated in timed relation with said ram for closing the shutter of a mold upon withdrawal of the ram.

45. In apparatus of the class described, and in combination, a conveyor, a plurality of open ended carrier molds carried thereby, a reciprocating charge-inserting ram, a reciprocating charge-ejecting ram, shutters movably mounted at the ends of said molds, means for opening both shutters prior to the advance of the ejecting ram, means for closing one shutter of a mold after ejection of a charge, and means for closing the other shutter of that mold following the insertion of a new charge.

46. In apparatus of the class described, and in combination, an open-ended mold, and shutters movably mounted at the ends of the mold comprising freely slidable plates having off-center openings capacitated to be brought into and out of registry with the mold by the shutter movement.

47. In apparatus of the class described, and in combination, an open-ended mold, and shutters movably mounted at the ends of the mold comprising freely slidable plates having off-center openings capacitated to be brought into and out of registry with the mold by the shutter movement, and means for operating said shutters.

48. In apparatus of the class described, and in combination, a receiver for a measured charge of material, means for compressing the charge along its length to give it the desired cross section, a carrier mold, means for transferring the charge from the receiver to the carrier mold and compressing it endwise to give it the desired length, means for confining the compressed charge in the mold, means for supplying a heating medium and a cooling medium, and means for conveying the carrier mold through said heating and cooling mediums.

In testimony whereof, I have hereunto set my hand.

GEORGE GOEBEL.