Aug. 12, 1941. F. TROTZKE 2,252,219

CETRIFUGAL TUBE CASTING MACHINE

Filed Nov. 3, 1939 5 Sheets-Sheet 1

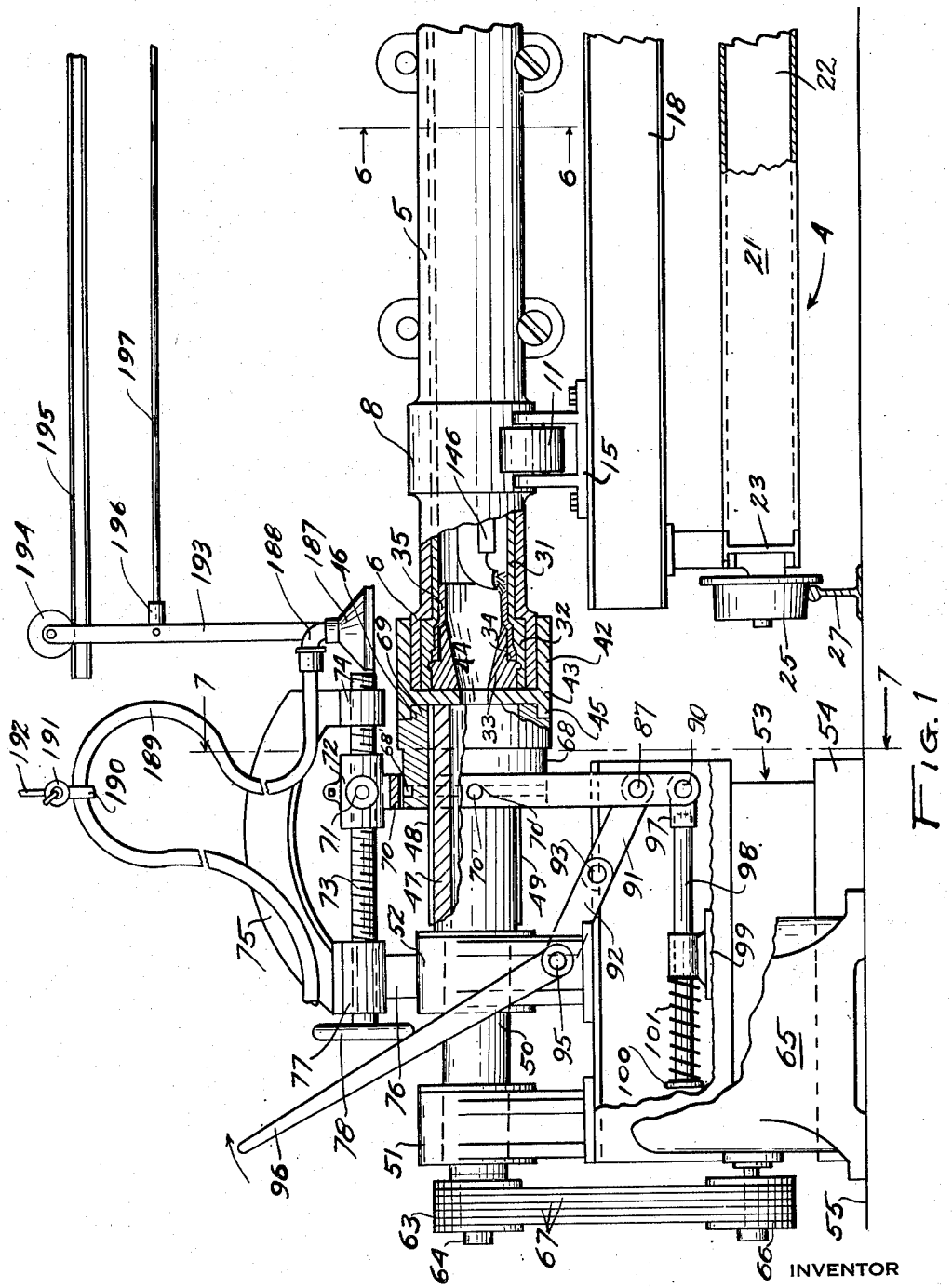


FIG. 1

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CETRIFUGAL TUBE CASTING MACHINE

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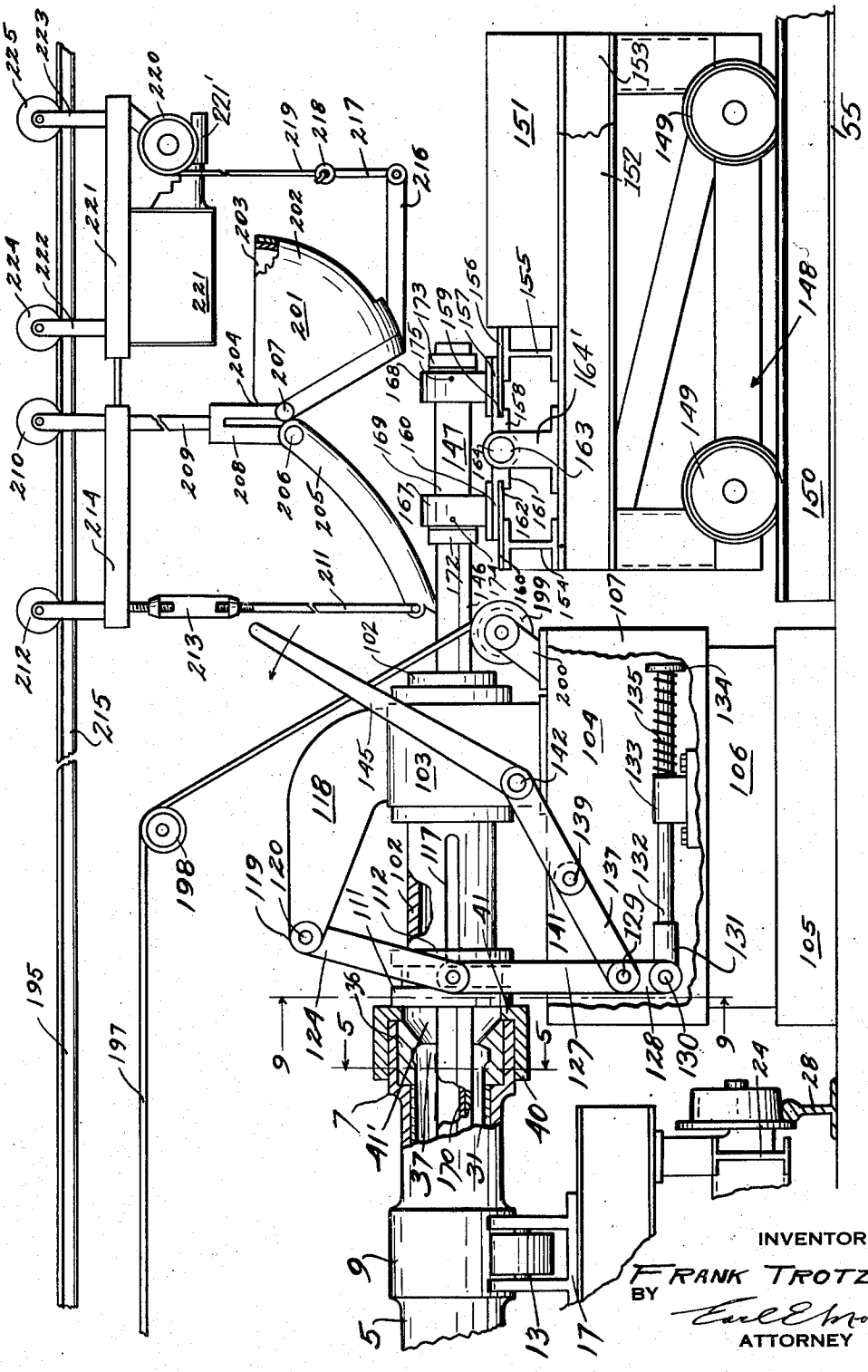


FIG. 2

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CETRIFUGAL TUBE CASTING MACHINE

Filed Nov. 3, 1939 5 Sheets-Sheet 3

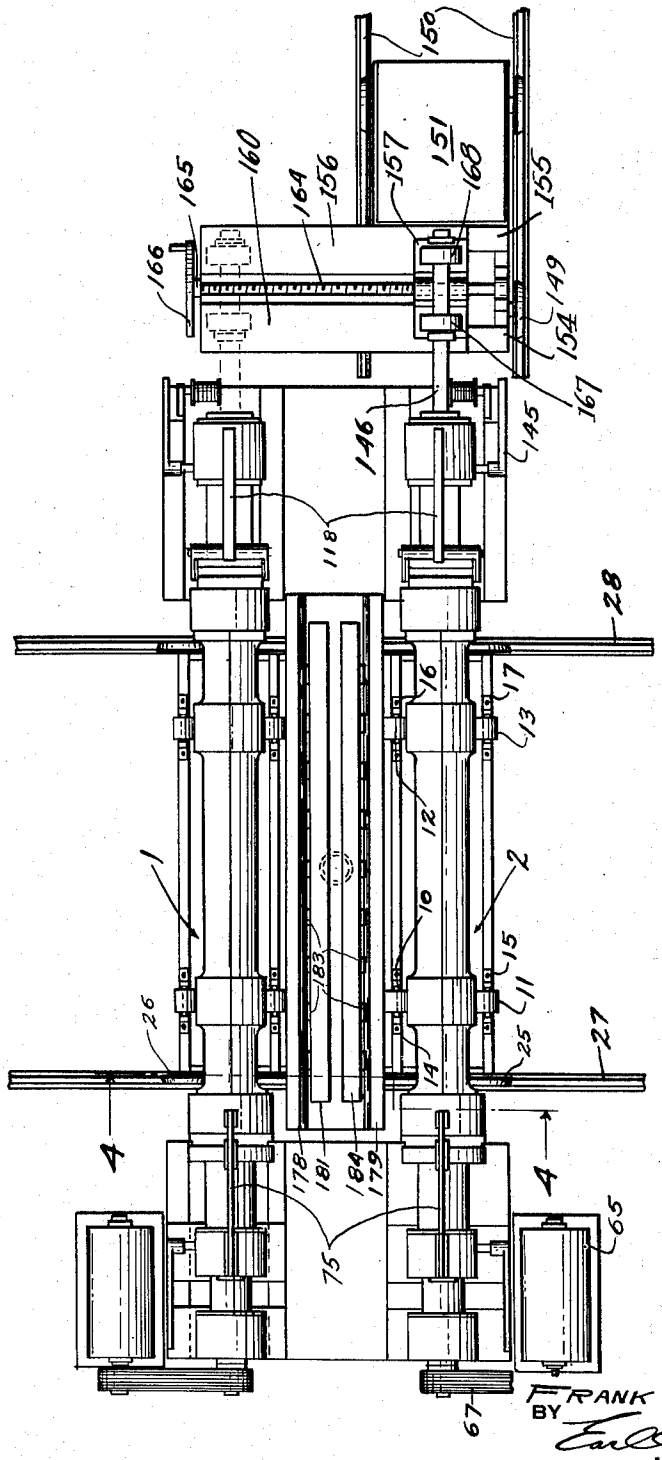


FIG. 3

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CETRIFUGAL TUBE CASTING MACHINE

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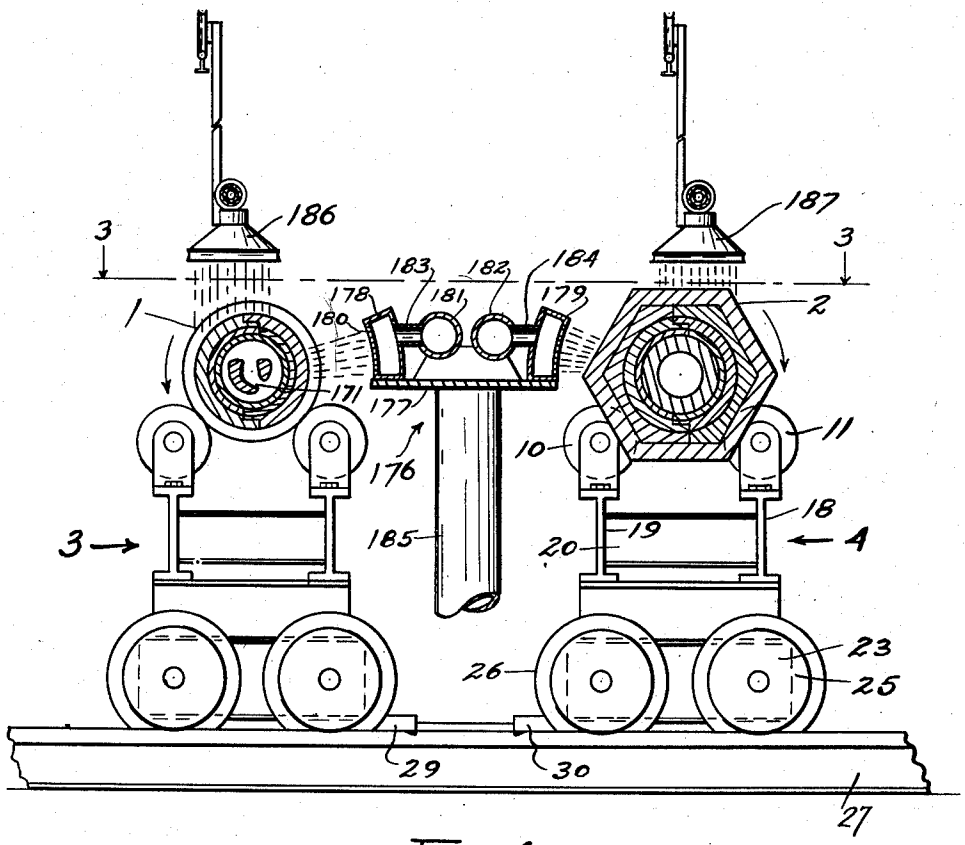


FIG. 4

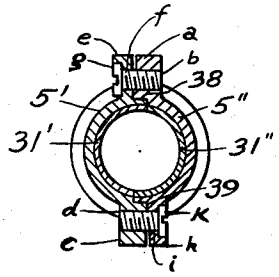


FIG. 6

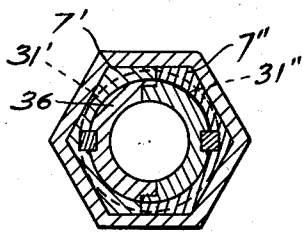


FIG. 5

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CETRIFUGAL TUBE CASTING MACHINE

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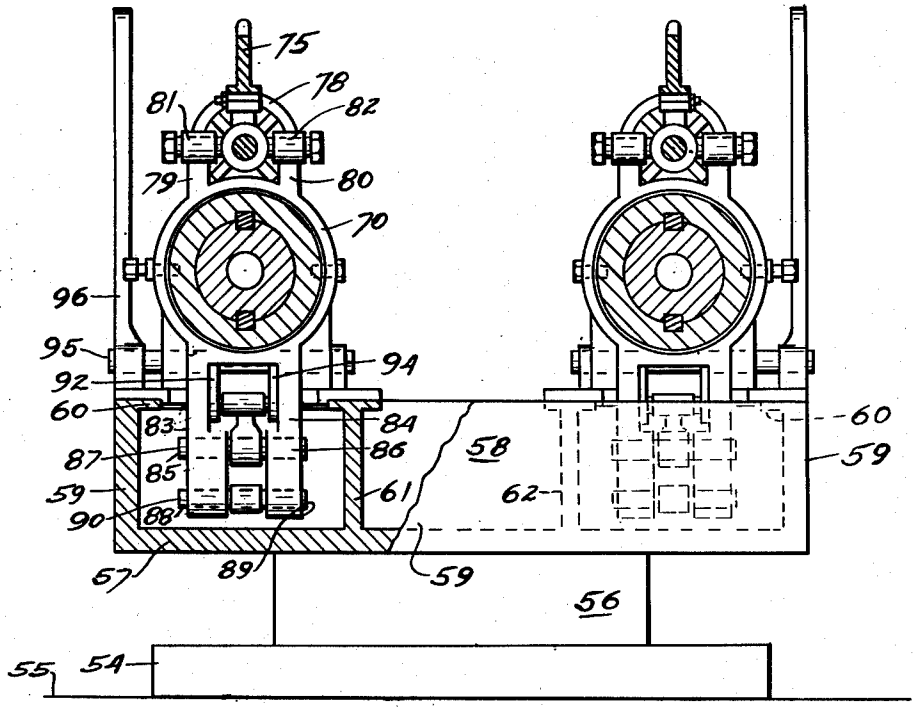


FIG. 7

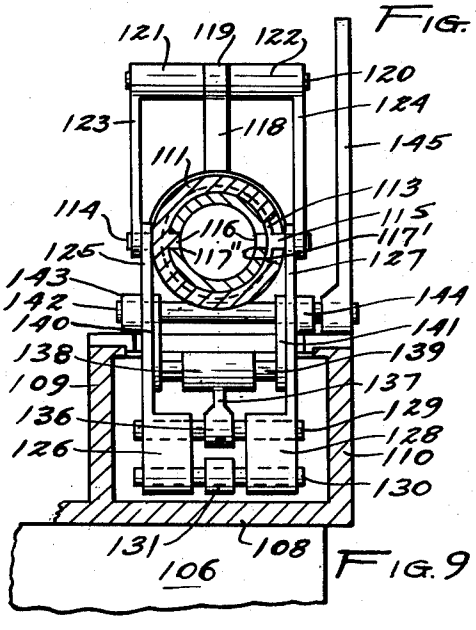


FIG. 9

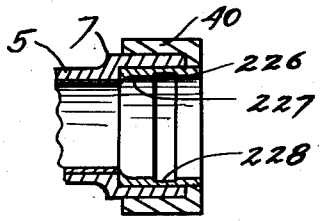


FIG. 8

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Patented Aug. 12, 1941 2,252,219

UNITED STATES PATENT OFFICE

2,252,219

CENTRIFUGAL TUBE CASTING MACHINE

Frank Trotzke, South Gate, Calif.

Application November 3, 1939, Serial No. 302,703

5 Claims. (Cl. 22—65)

This invention relates to new and novel processes for forming seamless tubing and the like by centrifugal force, and also to the apparatus for performing the processes.

My method and apparatus is a definite step forward to all prior ways of making seamless tubes through the use of centrifugal force. In accordance to my method, the material from which the tube is to be made, which may be molten metal or cementitious plastics, is poured at the starting end of a rotary mold while the mold is rotated at a speed high enough to keep the material against the lining of the mold until the material is sufficiently hardened to remain in place. When molten metal is used, the entire mold is kept at a working temperature by a heater which extends the full length thereof and has its heat directed against specific portions of the mold parallel to the axis thereof. Cooling means are provided which follows the progress of the pouring of the material and is situated to be effective after the freshly poured material has passed through its highest heat zone in the mold. This latter feature allows the freshly poured material to thoroughly adjust itself by causing it to evenly spread over the immediate surface of the liner to its proper thickness before it is chilled and partially set. This results in a more even dimensioned tube of uniform texture. By careful adjustment of the pouring speed and spread of the material with respect to the mold's rotary speed, thinner and stronger tubes can be made than by the conventional methods now employed.

The cooling means also prevent the mold from becoming too hot where the pouring takes place and hence reduces the danger of mold flexure and resulting in disalinement of the mold with its supports.

Furthermore, means are arranged for supplying a plurality of molds with material from a single trough of a feeding apparatus. The apparatus is positioned to permit only a minimum of exposure of the flowing material to the atmospheric air and temperature regardless of the pouring position of the trough in any one of the molds. This minimum of exposure is constant for all molds and independent of any particular portion of the tube being poured.

The molds are separable along the longitudinal axis thereof to permit easy removal of the newly formed tube with the least danger of damaging either the tube or mold. The ends of the molds telescope removable sleeves which allows for easy and quick change of their end cores, the core outer surfaces being poured in the same manner as the main body of the tubes. However, when the spaces between linings and cores have confined deep recesses designed to form the tube hub ends, slightly longer pouring periods are necessary in order to give the recesses time to properly fill and hence form perfect hubs and bells at the tube ends. When the bores of the end cores are enlarged for direct pouring, to avoid deep channel pouring, then there is little or no change in the pouring speed or retracting movement of the trough.

The end sleeves have polygonal shaped outer surfaces. The mold ends which receive the power for turning them, have polygonal sockets designed to receive the polygonal plugs of the power supply apparatus. These plugs are reciprocable and arranged for perfect registration with the sockets at the end of their respective molds. This connection between the turning apparatus and the molds, together with the true and carefully adjusted rolling supports beneath the molds, results in a vibrationless rolling of the molds so as to avoid the charged molten material within the molds from bunching or thickening at portions thereof so as to cause finished tubing of uneven thicknesses.

When the invention is applied for making soil pipes and the like having a hub at one end and a spigot at the other end, the whole is formed of a thin, uniform and homogeneous mass in a rotary split mold from which the pipe can be safely removed without in any way endangering its structure. A special bushing is provided at the spigot end of the mold to convert it into a hub forming end when it is desired to manufacture double hub pipes which are wanted for pipe lines in conjunction with single hub pipes.

An object of the invention is to present methods and apparatus for manufacturing seamless tubing and the like in quantity by centrifugal action in a manner that the finished tubing will have an uniform thickness and texture.

Another object is to provide means and methods for economically and perfectly forming tubing efficiently with a minimum of equipment and space requirements.

Another object is to provide rotary split molds kept at proper temperatures and coordinated with means to compensate for expansion and contraction of the molds while in service for maintaining exact alinement thereof so as to cause even unvibrational rolling of the molds.

Still another object is to set forth a system for making tubes and pipes which has versatility of operation to meet the particular specifications

of the exact tube to be manufactured, and in a manner that the split molds can be quickly reintroduced into the rotary machine after emptying and securely clamped therein for receiving another charge of pipe forming material; the centrifugal castings being made in rapid succession under proper heat treatment so as to make later annealing of the castings unnecessary.

Other objects, advantages and features of my invention will appear from the accompanying drawings, the subjoined detailed description, the preamble of these specifications and the appended claims.

Applicant is about to illustrate and describe one of the forms of his invention in order to teach one how to practice the invention and how to make, use and vend the same, but it is to be understood that the drawings and description thereof are not to limit the invention in any sense whatsoever, except as limited by the appended claims.

In the drawings:

Fig. 1 of the drawings shows the left end of the invention in side elevation, parts being broken away to show portions thereof in section.

Fig. 2 shows the right end of the invention in side elevation, a continuation of that part of the invention shown in Fig. 1; parts of this figure of the invention also being broken away to show portions thereof in section.

Fig. 3 shows a plan view of the invention, on a smaller scale than that shown in Figs. 1 and 2, and taken substantially at the elevation indicated by the lines 3—3 of Fig. 4.

Fig. 4 shows a vertical cross section of the invention taken substantially along the line 4—4 of Fig. 3 but enlarged to agree with the measurement scale of Figs. 1 and 2.

Fig. 5 is a cross section taken substantially along the line 5—5 of Fig. 2.

Fig. 6 is a cross section taken substantially along the line 6—6 of Fig. 1.

Fig. 7 is a cross section taken substantially along the line 7—7 of Fig. 1.

Fig. 8 is a vertical section showing an interchangeable part of the invention.

Fig. 9 is a cross section taken substantially along the line 9—9 of Fig. 2.

The numerals 1 and 2 indicate, in general, spaced apart parallel rotary molds which are supported subjacently by the carriages or trucks 3 and 4 respectively.

Since the molds 1 and 2 and their respective trucks are identical in construction, only one of them will be described in detail in order to avoid burdening this application and unnecessarily marking the drawings. Each mold constitutes an elongated cast iron cylinder 5 having integral therewith enlarged ends or heads 6 and 7 as shown. The cylinder 5 has circular embossed surfaces 8 and 9 which are integral therewith and spaced apart along the longitudinal axis of the cylinder to provide true circular machined tires which are in rolling contact with their respective pairs of spaced apart rollers 10, 11 and 12 and 13. The rollers 10, 11, 12 and 13 are pivotedly supported by U-shaped straddles 14, 15, 16 and 17 respectively. The straddles are bolted or otherwise fixed to the top surfaces of horizontal I-beams 18 and 19, as shown.

The I-beams 18 and 19 are tied together by cross beams 20 which are spaced at intervals throughout the length of the beams 18 and 19 to provide a rigid frame for supporting the mold. The beams 18 and 19 are supported by channel members 21 and 22 having their ends cut to rest upon the bottom flanges of cross I-beams 23 and 24, each end of which are provided with the usual block bearing and rail wheel units 25 and 26. The numerals 27 and 28 represent standard size steel rails upon which the entire carriage with its mold is shiftable in the direction at right angles to the axis of the mold. Rail stops 29 and 30 are provided to prevent the carriages 3 and 4 colliding and damaging intermediate equipment and also to stop the carriage at the proper place so that the molds are in perfect alinement with other apparatus to be later described.

Each of the molds are provided with refractory lining material 31 which receives the hot molten metal from which the tube is to be formed, the lining extending from end to end of the mold as shown. At the heads 6 and 7 of the mold, the liner is recessed and configurated as shown to follow the general internal contour of the mold. Fig. 1 shows the left end of one of the molds in which the liner end 32 in conjunction with the conical-like sand core 33, provides a deep annular recess portion 34 which receives the hot metal to form the enlarged tube end or hub as indicated at 35.

The other end of each mold is provided with a sand core or metal bushing 36 having the large central opening 37 which forms the mouth of the mold for receiving the trough to feed metal to the mold. This sand core or metal bushing has its internal surfaces configurated to form the spigot end of the tube.

The mold is split axially and formed into complementary parts by the upper and lower staggered cuts 38 and 39 respectively, as clearly shown in Figs. 5 and 6. The liner 31 has abutting sectors 31′ and 31″, the shell of the mold including elements 5, 6, 7, 8 and 9 and also have abutting segments; the mold proper 5 having the segments 5′, 5″, the mold end 7 having segments 7′, 7″, and the embossed sections 8 and 9 having sectors similarly arranged in abutting relationship. By this arrangement, the entire mold can be separated so that the new formed tube can be lifted from the mold.

In order to hold the opposing segments of the mold together, note Figs. 1 and 6, the segment 5″ is provided with a protrusion or extension *a* having an internal threaded bore *b*, the sector 5′ has at its bottom a similar protrusion *c* with an internal threaded bore *d*. Opposite the protrusion *a* is a protrusion *e*, affixed to the top of sector 5′, having an unthreaded bore *f*. Through the bore *f* passes a head screw *g* which is in threaded engagement with the threads of bore *b*. The bottom of sector 5″ has a similar protrusion *h* and a bore *i* through which passes a headed screw *k* which is in threaded engagement with the bore *d*. By this arrangement, the two halves of the mold cylinder can be separated after the screws *g* and *k* are removed and providing the end sleeves of the mold, to be later explained, are removed.

The end 7 of each mold has its outer surfaces shaped into a hexagon and over which fits snugly a sleeve 40 which has its internal and external surfaces shaped into a hexagon. The sleeve is provided with an internally extending flange 41 which engages an out edge of core 36 so as to hold it in place, the flange forms a large central opening 41′. The other end of the mold is provided with similar sleeve 42 which also has hexagonal inner and outer surfaces, the internal hexagon surface snugly fitting the exterior hexagonal surface of the mold embossed end 6. The sleeve

42 has an inwardly turned flange 43 forming a relatively small central aperture 44, the flange 43 abutting the ends of the member 6, liner 32, and sand core 33. Integral with the sleeve is an outstanding flange 45 which has its outer surface shaped to conform with the outer surface of the sleeve, and an inner surface 46 which is also hexagonal in shape.

Each power apparatus for rotating its respective mold consists of a hollow cylinder 47 having at its top surface a key 48 and at its lower surface a key 49. These keys being integral therewith. The cylinder has a reduced cylindrical portion 50 which is journalled by the bearing standards 51 and 52, as shown. These bearing standards provide a cantilever support for the cylinder end 47 so that it can be rotated and have free outer surfaces for a purpose to be explained. The bearing standards are supported by a base or table denoted in general by the numeral 53. The base has a footing of heavy plate indicated by 54 which is affixed to a concrete foundation or other type of suitable flooring provided in the mill and denoted by numeral 55. A heavy metallic block 56 surmounts the plate 54 and supports the bottom 57 of an open top of a box-like housing 58, see Fig. 7. The vertical sides of the housing 58 consist of a peripheral wall 59 having inturned top flanges 60. The box is divided by vertical partitions 61 and 62 having flanged top ends to form wells, as shown.

One end of the cylinder 50 is provided with a multi-grooved pulley 63 which is mounted upon a hollow shaft 64 fixed to the cylinder. By making the parts hollow, the operator of the mold can have clear view and vision through the shaft, cylinders 49 and 50 and aperture 44, in order for him to observe the progress of the work within the mold. Upon the foundation 55 is mountable a variable speed electric motor 65 having upon its shaft a multi-grooved pulley 66. The pulley 63 and 66 are connected together by multi-V-type belts 67 for delivering rotary power from the motor to the cylinders 49 and 50 and hence the mold 5.

A socket 68 is concentric with the cylinder 49 and is provided with top and bottom key-ways in sliding contact with the keys 48 and 49 so that it can slide axially along the cylinder 49 and receive its rotary power from the cylinder at any position therealong. The socket is provided with a reduced hexagon extension 69 which is keyed to or otherwise affixed to the sleeve 42 so that when the socket is forced away from the end of the mold, it will carry the sleeve with it and thus uncover the mold end 6.

To shift the socket along the cylinder 49, a ring 70 is provided which is spaced from the socket and concentric therewith. The top of the ring is pivoted at 71 to extending pins which are part of an internally threaded sleeve 72. The sleeve is in threaded engagement with a horizontal shaft or worm 73. The worm is journalled at one end in a bearing 74 at the end of a cantilever arm 75. This arm is firmly fixed to the top of bearing standard 52 by a block 76. Intermediate the block and cantilever arm is a threaded sleeve 77 through which passes the threaded shaft or worm 73. One end of the shaft is provided with a hand wheel 78 which is operative to turn the worm and hence position and adjust the pivot 71 where desired. The ring 70 is provided along each side with a stud 70' that rides in the rotary annular recess 68'.

As shown best in Fig. 7, the ring 70 is provided with upwardly extending arms 79 and 80 having bearings 81 and 82 respectively which have bearing engagement with the pivot pin 71. Integral with the ring 70 at the bottom thereof are spaced apart downwardly extending legs 83 and 84. Each leg is provided with bearing bores 85 and 86 and support the pin 87. At the extreme bottom ends of the legs are bearing bores 88 and 89 which accommodate the support pin 90. Attached to the support pin 87 is one end of a link rod 91 connected to another link rod 92 by pivot pin 93. The link rod 92 and a similar companion link rod 94, see Fig. 7, are rigidly attached to a shaft 95 which is provided with the lever 96. The center portion of the support pin 90 is engaged by a connector 97 which has threaded engagement with one end of a rod 98. The rod 98 is supported by bearing standard 99 which is attached to the floor 57 of the housing. One end of the rod 98 is provided with an integral flange end 100. Intermediate the end 100 and the bearing standard 99, and encircling the rod 98, is a compression spring 101.

By moving the lever in the direction indicated by the arrow, the arm 92 moves downwardly and forces the ring 70 to the left so as to pull the sleeve 42 from the end of the mold. This is accomplished with the aid of compression spring 101. Since the mold expands when heated, the pivot 71 must be moved slightly toward the wheel 78 in order to avoid any risk of buckling the mold.

The sleeve 40, at the other end of the mold, is removed therefrom by somewhat similar mechanism consisting of a hollow cylinder 102. This hollow cylinder 102 is supported in cantilever fashion by a bearing standard 103 which is supported by a heavy cast iron box-like table 104. The table 104 is constructed similar to the table 53, shown in Fig. 7. This table 104, however, has a base 105, see Fig. 2, which is supported upon the foundation 55 of the building. A heavy block 106 is supported by the base 105 and has surmounted thereon the box-like structure 107. Since the duplication of parts is necessary, and in order to simplify the showing of the invention, only one side of the box and its mechanism will be described.

The box consists of a bottom wall 108 having integral therewith vertical walls 109 and 110 spaced apart, as shown, to accommodate certain control mechanism for removing the sleeve 40 from the end of the mold 2. One end of the cylinder 102, has fixed thereto spaced apart collars 111 and 112, the collar 111 having one of its side faces welded to or otherwise securely fixed to the inturned flange 41 of the sleeve 40 so that when the collars are moved to the right, they will pull the sleeve 40 from the end 7 of the mold. Within the groove between the collars 111 and 112, is a slip ring 113, see Fig. 9, having laterally integral studs 114 and 115 which are arranged to act as pivot pins for parts to be presently explained. The collars 111 and 112 are provided with internally extending studs 116 which are adapted and arranged for sliding movement in the grooves 117 and 117' at the sides of the cylinder 102. Mounted on top of the bearing housing 103 is a cantilever arm 118 having an end portion thereof extending toward the mold to form a support bearing 119 equipped with a pin 120. Mounted upon the pin are sleeve bearings 121 and 122 which have fixed thereto links 123 and 124 respectively. The lower end of the link 123 is pivotly connected to the outer

end of the stud 114 of the slip ring and the lower end of the link 124 is pivotly connected to the stud 115 of the slip ring. Intermediate the link 123 and the collars 111 and 112, is pivoted one end of a link 125 which extends downwardly into the housing of the table wherein its end is formed into a pivot block 126. Intermediate the lower end of the link 124 and the collars 111 and 112, is pivoted the top end of a link 127 which also extends downwardly and into the housing of the table wherein it is provided with a bearing block 128. Pins 129 and 130 are fixed in the upper and lower ends respectively of the blocks 126 and 128. The lower pin provides a bearing for the connector 131 which is fixed to a rod 132 that is supported by the bearing block 133. The end of the rod 132 is provided with a stop or flange 134. Between the stop 134 and the bearing 133 is a compression spring 135. The upper pin 129 supports the bearing end 136 of a link 137, one end of which has a bearing sleeve 138 which is supported by a pin 139. Fixed to one end of a pin is a link 140 and to the other end, another link 141, both of these links extending to a shaft 142. Bearing blocks 143 and 144 fixed to the sides of the bearing standard 103 supports the shaft 142. A lever 145 is fixed to the shaft 142.

By pulling the lever 145 in the direction indicated by the arrow at the top thereof, see Fig. 2, the links 125 and 127 are forced from the mold end 7 so as to carry the collars 111 and 112 along the cylinder 102. This action removing the cap 40 from the end 7 of the mold.

Molds 1 and 2 are fed by a common trough which consists of a structural U-shaped outer frame 146 which is of very strong steel and long enough to extend from the far end 6 of either mold to a laterally adjustable carriage 147 situated beyond the other end of the mold. The carriage is fixed to a reciprocable truck 148, which is of a crate-like steel structural device having wheels 149 which ride along a track 150. At the top and toward one end of the truck is a heavy ballast 151 having sufficient weight to much more than counter-balance the carriage 147, and the trough 146 with its various parts as well as the molten metal which it is designed to carry. The truck is provided with I-beams 152 and 153 along the top sides thereof to support in fixed relation therewith cantilever beams 154 and 155 which extend beyond the longitudinal axis of molds 1 and 2. Fixed to the top of I-beams 154 is an elongated guide plate 160 extending substantially the length of the beam 154, and fixed to the top of the beam 155 and spaced from plate 160 is a similar guide plate 156 which also is co-extensive with its supporting beam.

Mounted on the guide plate is a slide plate 157 having one edge thereof flanged, as shown at 158, to curve in under the guide plate to provide a groove 159 for receiving the slide plate in sliding engagement. A similar slide plate 160 has a flanged edge 161 which is also formed to provide a groove 162 to accommodate the edge of the guide plate 155. Fixed to and intermediate flanges 158 and 161 is an internally threaded sleeve 163 which is in threaded engagement with an elongated wormshaft 164. The wormshaft is supported by bearing 164' and extends to the opposite ends of the guide plates 155 and 156 where it is supported by bearing 165, the end of the shaft extending through the bearing and having fixed to its end a hand wheel 166. The parts are arranged in a manner so that when the hand wheel is rotated in one direction, it will draw the carriage 147 and the trough into alinement with the mouth opening of mold 1; and when rotated in the opposite direction, it will force the carriage and the trough into alinement with the bore of mold 2. Fixed to the top of the slide plate 160 and 157 are standards 167 and 168 which support a horizontal block 169 having a rectangular bore into which, snugly and rigidly, is fixed one end of the trough 146. One end of the trough passes through the bore of the cylinder block 169, and is provided with collars 172 and 173, as shown in Fig. 2. These collars have rectangular bores and are slightly tapered so that when the trough is placed within the cylinder 169, the collars 172 and 173 are hammered or otherwise forced toward their respective bearing blocks 167 and 168 so as to securely wedge and hold the trough onto the carriage 147 and hence the truck 148. When the collars are securely forced into place, they are prevented from being dislodged by the action of their respective set screws 174 and 175.

The outer sheel 146 of the trough has a U-shaped cross section with open top along its entire length. The very end of the trough is provided with a pouring spout 171 at the side thereof so as to avoid agitation as much as possible as the metal is poured into place upon the liner, see Fig. 4. The liner of refractory material 171, of course, extends the full length of the trough and along the sides thereof so as to avoid injuring the structural parts of the trough.

The mold is kept heated substantially along its entire length by a gas flame unit indicated in general by the numeral 176, see Fig. 4. A heavy plate 177 extends substantially the full length of the mold and between them, and is supported by any suitable means, not shown, the plate is the subjacent support for the heating ducts 178 and 179 which also extend substantially the full length of the molds. These boxes are closed by top, bottom, end and side walls; the front walls are slightly curved, as shown, and provided with a large number of perforations 180 for directing evenly distributed heat over the entire axle length of the molds at the positions shown. Tubes 181 and 182 run parallel to and between the heat ducts 178 and 179 and feed the heated gas to their respective boxes by the way of the plurality of evenly spaced apart connecting tubes 183 and 184 as shown. The tubes 181 and 182 are supplied by the large main feeder duct 185 which receives this supply of hot gas from any source, not shown, which may be any kind of furnace for the purpose.

Molds 1 and 2 are cooled by their respective shower heads 186 and 187, see Fig. 4, both of which are perforated along their bottom surfaces so as to cause a large supply of evenly distributed water to fall upon the mold portions beneath their respective heads. As shown in Fig. 1, each head is provided with a curved fitting 188 which is connected to a long flexible hose 189 which leads to a supply of water that is kept at some predetermined cooled temperature. The hose is supported by a strap 190 having an eyelet 191 which is connected to a flexible cable 192. The cable is suspended at a point high above the mold so that when the watering unit is pulled along the mold to follow the end of the pouring trough, there will be no difficulty in moving the head from end to end of the mold. The watering unit and head is supported by a metallic strap

193 which has one end firmly fixed to the head and the other end to a pulley 194 which rides along a single rail 195. At some point intermediate the ends of the strap, there is a connector 196 fixed thereto and firmly fixed to a long flexible cable 197 which passes over a fixed pulley 198, see Fig. 2, and has the end thereof anchored to a drum 199 which is supported for rotary action by a bracket 200 fixed to the top of the table 104. The drum 199 is arranged for releasable frictional contact with the bottom or sides of the trough so that when the trough is withdrawn from the mold, it will cause the drum 199 to rotate and wind the cable 197 thereon and thus cause the sprinkler head above its respective mold to follow the pouring end of the trough 146. The flexible hose is pivoted in a position so that its weight in conjunction with its various fittings and watering head are sufficient to cause same, by gravity, to fall back to the tail end of the mold whenever the drum is released from frictional contact with the trough.

The feeding end of each mold is provided with a ladle 201 for holding a predetermined amount of molten metal from which the tube is to be made. The ladle consists of an iron body 202, configurated as shown, with an open top 203 which converges into a suitable pouring spout at 204. Arranged adjacent the pouring spout is an adjustable short trough 205 lined with suitable refractory material. The adjacent points of the ladle and short trough are provided with pivoted connectors 206 and 207 which are supported by a pair of overhead inverted U-shaped bars 208 which have connected at their top a rod 209 leading to a pulley 210. The lower end of the short trough is pivotly supported by a rod 211 which has at its top end a pulley 212. Intermediate the pulley end and the short trough is a rod adjuster 213 so that the rod 211 can be shortened or lengthened for the obvious purpose of placing the short trough end close to the bottom of the large trough 146. A stiffener 214 fixes the rod 209 and 213 in spaced apart relationship. The pulleys 210 and 212 are arranged to run upon a track 215 supported in any suitable manner. At the lower end of the ladle is an arm 216 firmly fixed thereto and is provided with a rod 217 pivotly connected therewith, the rod has an eyelet 218 through which passes, and firmly secured thereto, an end of a flexible cable 219. The cable is arranged to wind upon a drum 220 of a variable speed electrical motor 221 via a reversible mechanism 221'. The drum and motor are supported by a block 221 having at its ends bar 222 and 223 with pulleys 224 and 225 respectively. These pulleys ride upon track 215.

In Fig. 2, the right hand end of the mold is shown with the sand core or metal bushing 36 designed for forming the spigot end of the tube or pipe, but, however, it is necessary to form tubes having both ends in the form of hubs, and in view of this, the invention also includes an alternative means at the end 7 of the mold for forming hubs. In the event that the tube is to be made with double hubs, the sand core 36 is not inserted in the end 7 of the mold, but in its place is placed a bushing 226, see Fig. 8, which is formed of lining refractory material and configurated to form the hub 227 and bell 228 by the usual centrifugal force pouring method used in forming the spigot end as shown in Fig. 2. The mold, therefore, is adapted for making tubes with a hub and spigot end or tubes with a hub on each end.

Although a refractory lining 31 is shown within the mold, it is generally preferable not to use such a lining for the reason that the tube can be successfully formed by a centrifugal action upon the inner surface of the cast iron mold 5. Such a preferable construction avoids complications in its use, one of which may be cracking or damaging of the refractory material and causing delay in replacing same.

After the newly formed tube is completed in mold 1 and the trough completely withdrawn therefrom, as well as from the cylinders upon the table 106, the trough is shifted and inserted into the other mold 2 to form a tube therein while mold 1 is shifted laterally upon the track 27 away from the heater 178, to a point where the mold is cooled and then split apart for removing the newly formed tube. Thereafter the rotary mold 1 is returned to position as shown in Fig. 3, at which time the mold 2 is ready for shifting laterally away from its heater and the trough then inserted into mold 1 to start operation to form a new tube therein. By such a procedure, the entire assembly is kept in constant operation so that newly formed tubes can be rapidly made without either mold being in idleness for any appreciable length of time.

Having thus described my invention, what is claimed as new and desired to be secured by Letters Patent is:

1. A rotary mold for the manufacture of homogeneous tubes and the like, a cylindrical mold split longitudinally, a removable sleeve-like head having a polygonal bore at each end of the mold for supporting it and clamping it together, one of the heads having a coupling for connection with a rotary driving means and the other head having fixed relation with a mechanism to give it rotary support and to force it onto and from the mold end, micro-adjustable means at one of the mold ends for compensating for expansion and contraction of the mold and maintaining it in alinement and connection with its end supports.

2. In a centrifugal tube casting machine comprising an elongated mold rotatably supported between the ends thereof upon a carriage for laterally moving the mold, mechanism at one end of the mold for rotating it, means intermediate the mechanism and said one end of the mold for releasably connecting the mechanism and mold together, said means having a central opening and said mechanism having an open bore therethrough from end to end so that the operator can peer through the entire length of the mechanism and mold.

3. In a device for centrifugally casting seamless tubing, a rotary mold, pouring means for feeding tube forming material in the mold from end to end thereof and along the bottom thereof while it is rotating, elongated heating means along one side of the mold and cooling means along the top of the mold and arranged to follow the pouring means, said mold having a direction of rotation so as to cause the newly poured material from the trough to first pass by the heating means before passing by the cooling means.

4. In a device for centrifugally forming a plurality of seamless tubes, a pair of spaced apart split molds in parallel, each mold having tail ends and mouth ends, means between the molds for heating them, a trough mechanism adapted to insert a trough through the mouth of either mold, and mechanism to adjust the trough in-

side of the mold sideways according to thickness of the pipe, retractable means at the ends of the molds and having sleeves to fit over the ends of the molds to hold them together, the ends of the molds having polygon heads and the sleeves polygon bores which snugly fit the heads, and cooling means over the molds designed to follow an end of the trough.

5. In a centrifugal tube forming apparatus having an elongated rotary mold with a mouth at one end, a trough having a pouring spout adjacent the mouth of the mold and adapted to be inserted through the mouth to near the other end of the mold, a water spray above the mold and adapted to be extended along the mold, pulley means operated by the outer surface of the trough to cause the spray to follow the pouring spout of the trough.

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