March 4, 1952 F. M. DARNER 2,587,975

APPARATUS FOR FORMING CYLINDRICAL SHAPES

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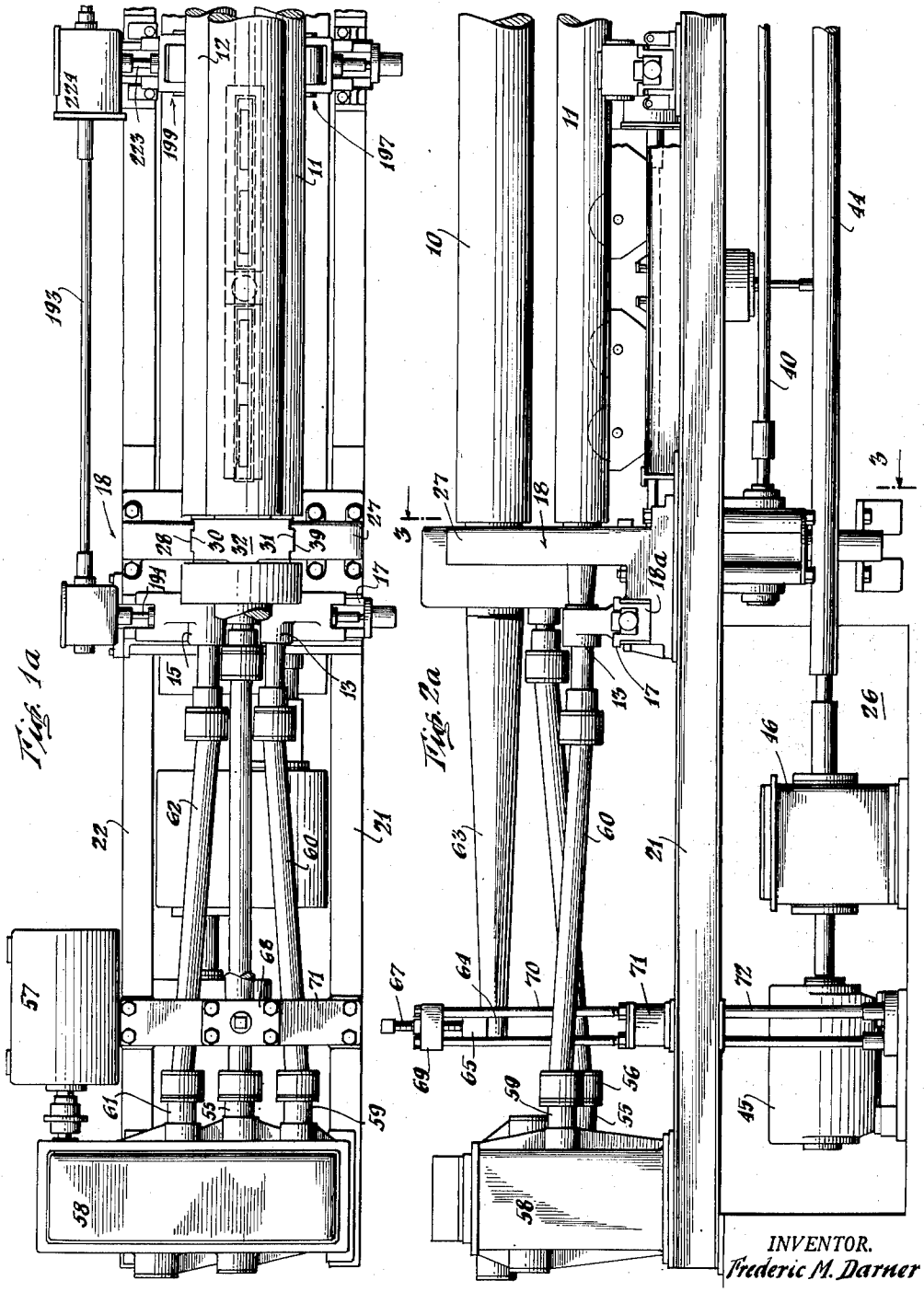


Fig. 1a

Fig. 2a

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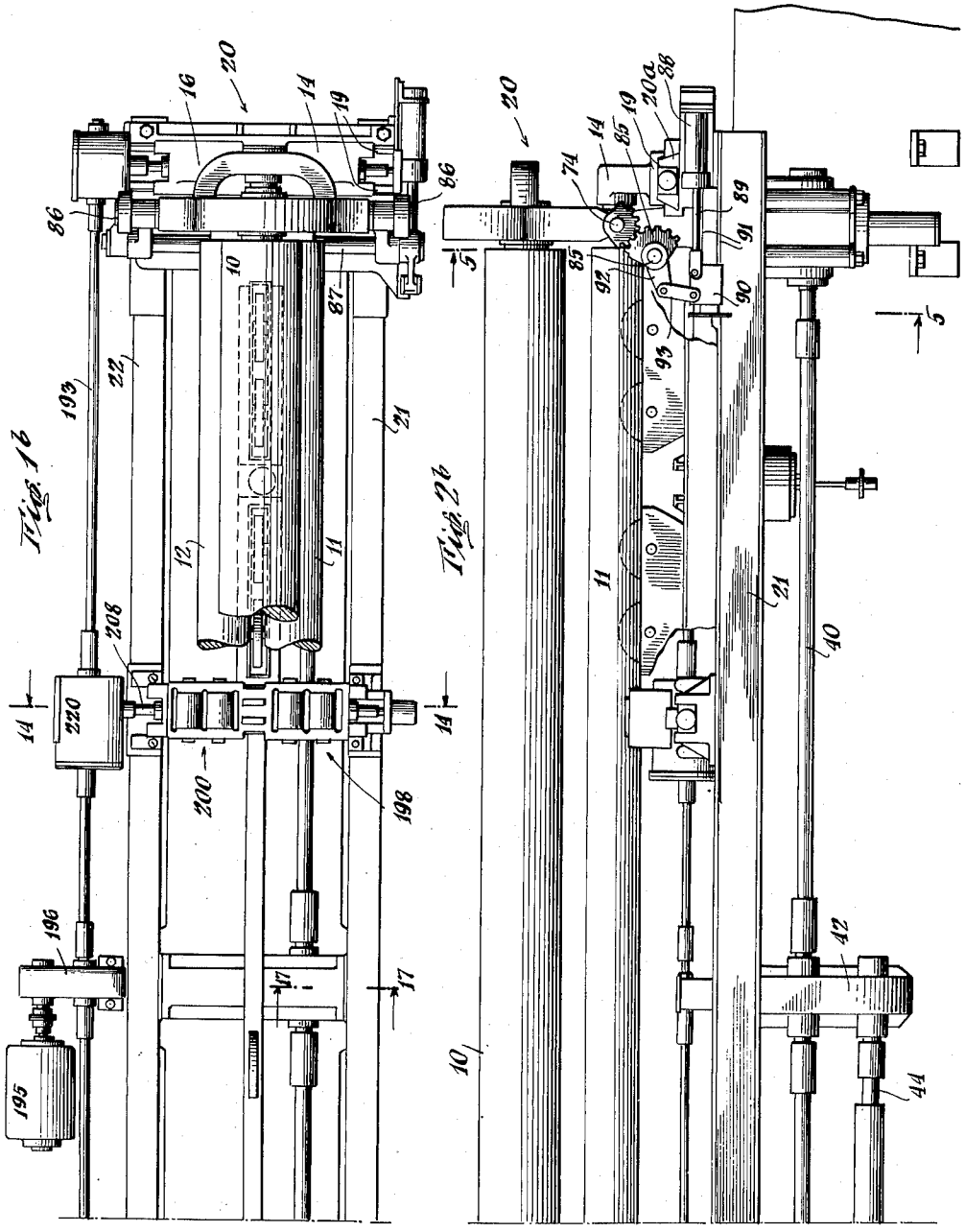
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APPARATUS FOR FORMING CYLINDRICAL SHAPES

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Filed June 14, 1949 11 Sheets-Sheet 3

Fig. 3

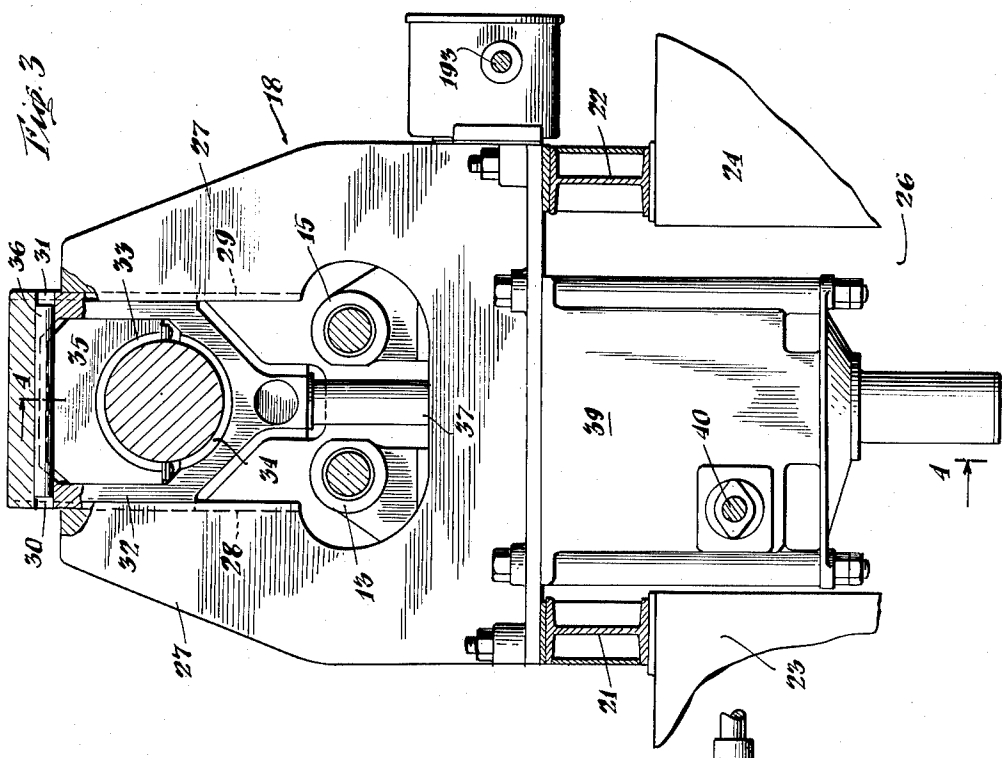
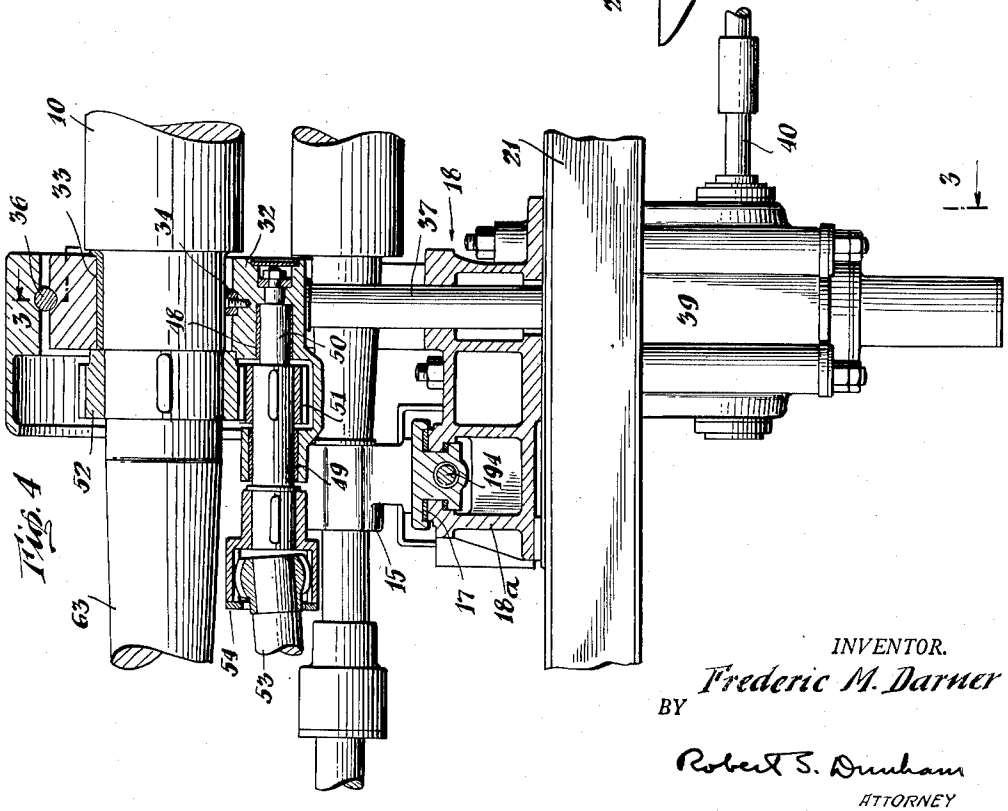


Fig. 4



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Filed June 14, 1949 11 Sheets-Sheet 4

Fig. 6

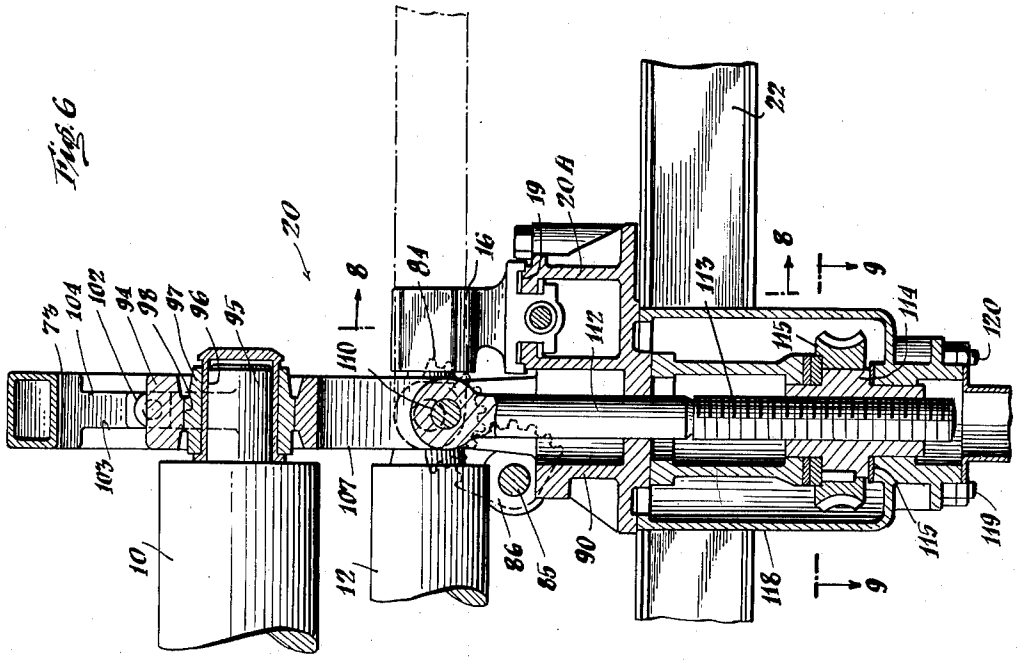
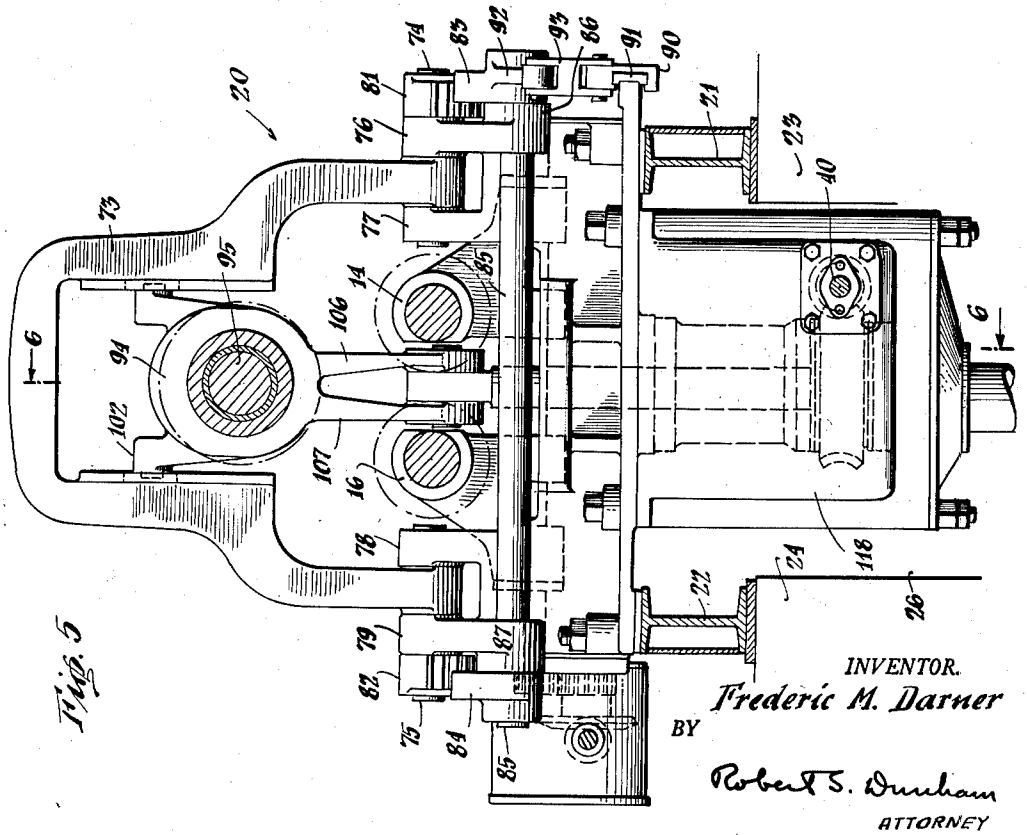


Fig. 5



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Filed June 14, 1949 11 Sheets-Sheet 5

Fig. 7

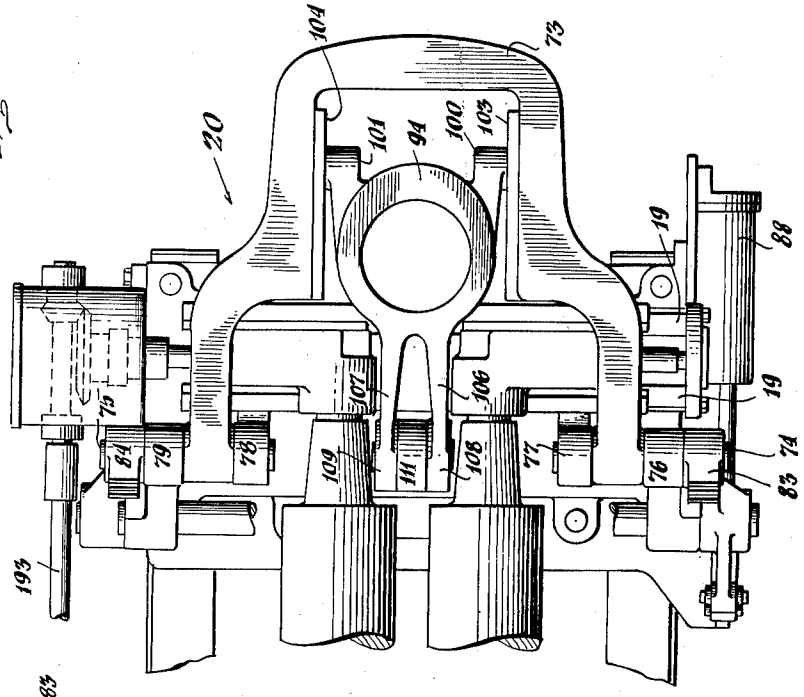


Fig. 8

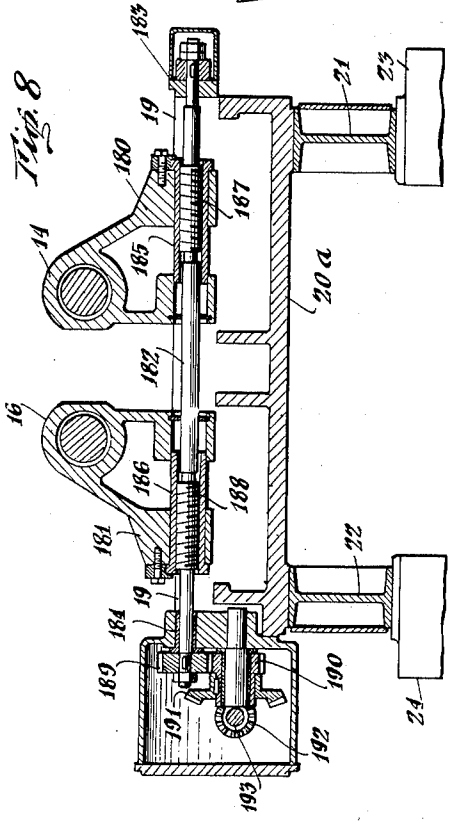
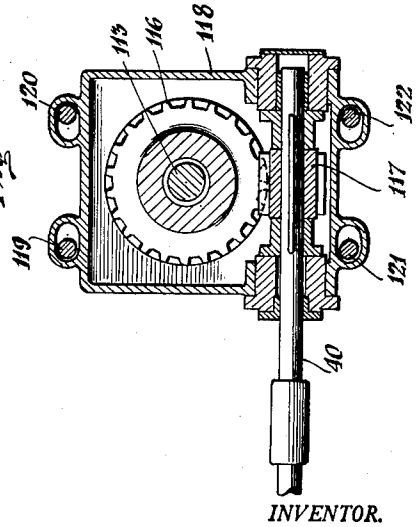


Fig. 9



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March 4, 1952 F. M. DARNER 2,587,975

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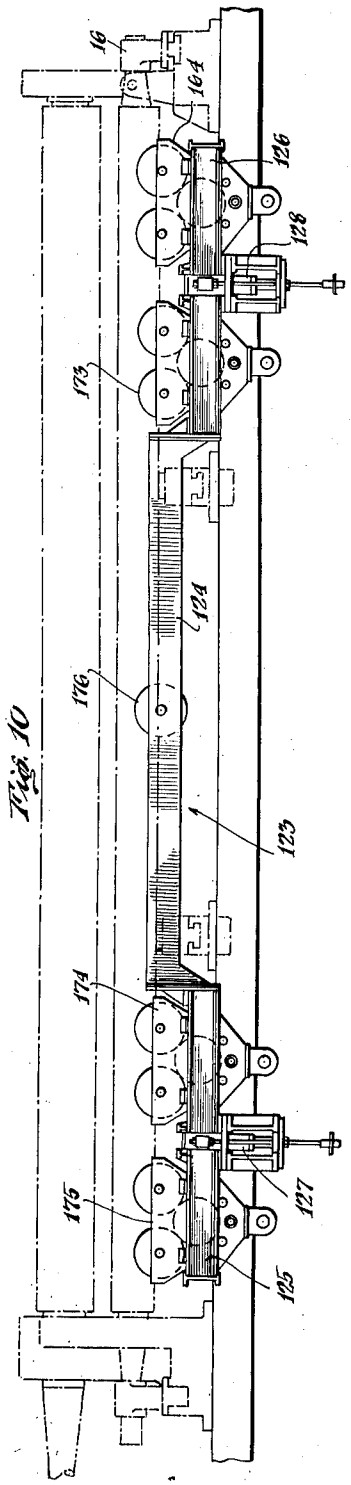


Fig. 10

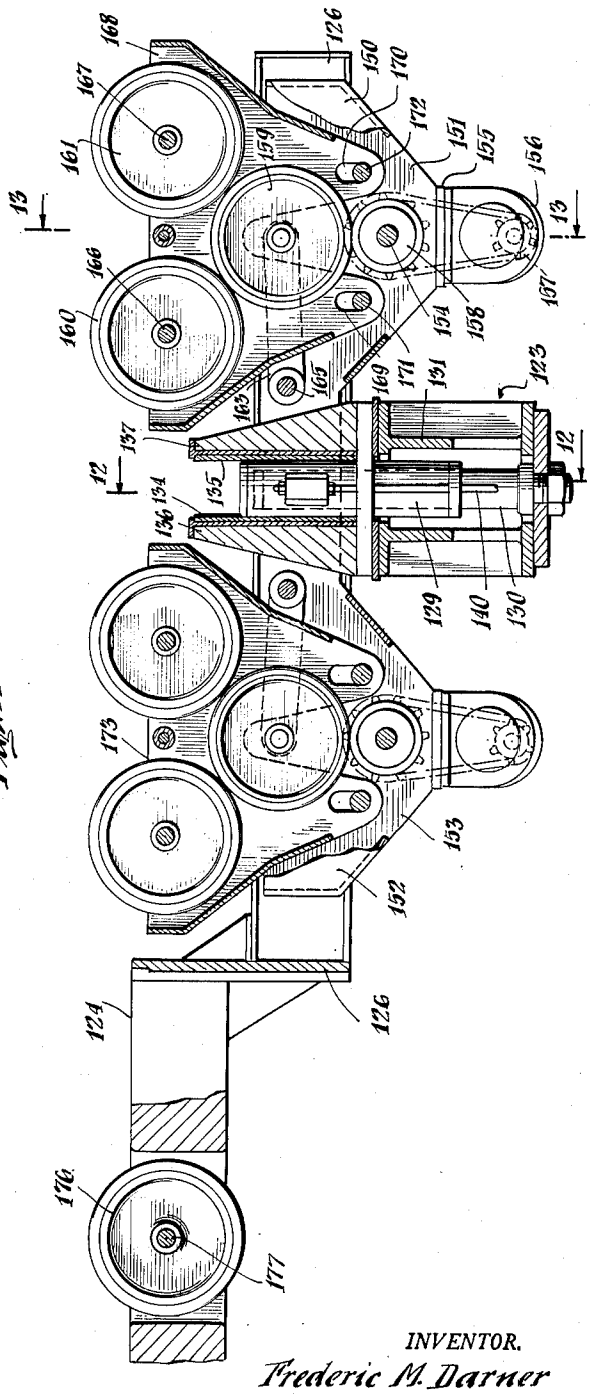


Fig. 11

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Filed June 14, 1949 11 Sheets-Sheet 7

Fig. 12

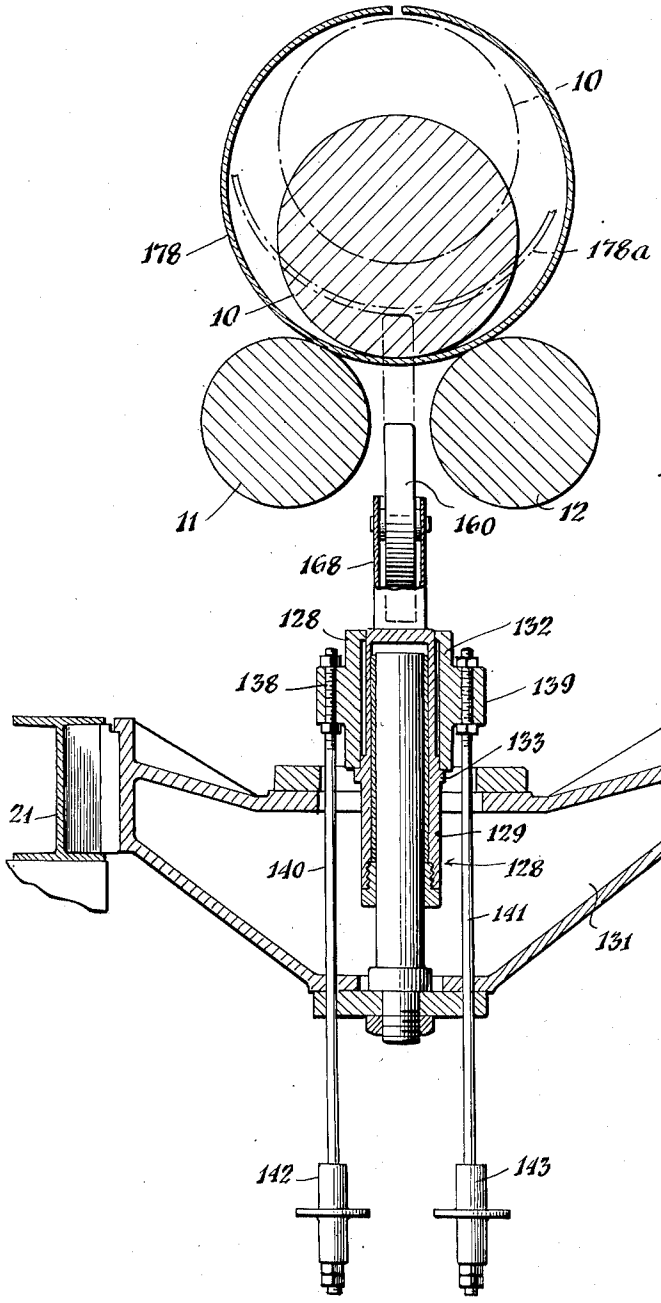
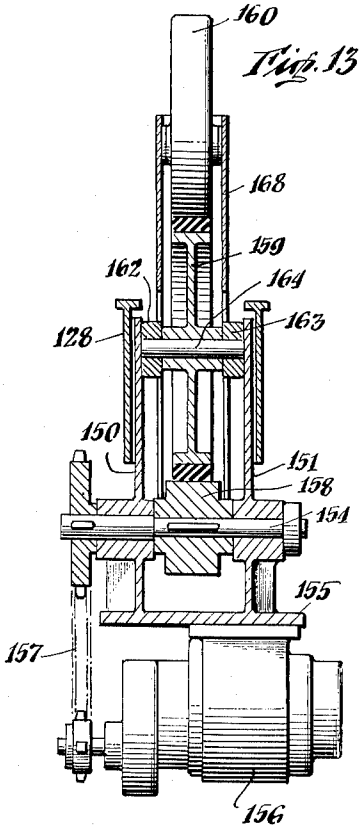


Fig. 13



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Filed June 14, 1949 11 Sheets-Sheet 8

Fig. 14

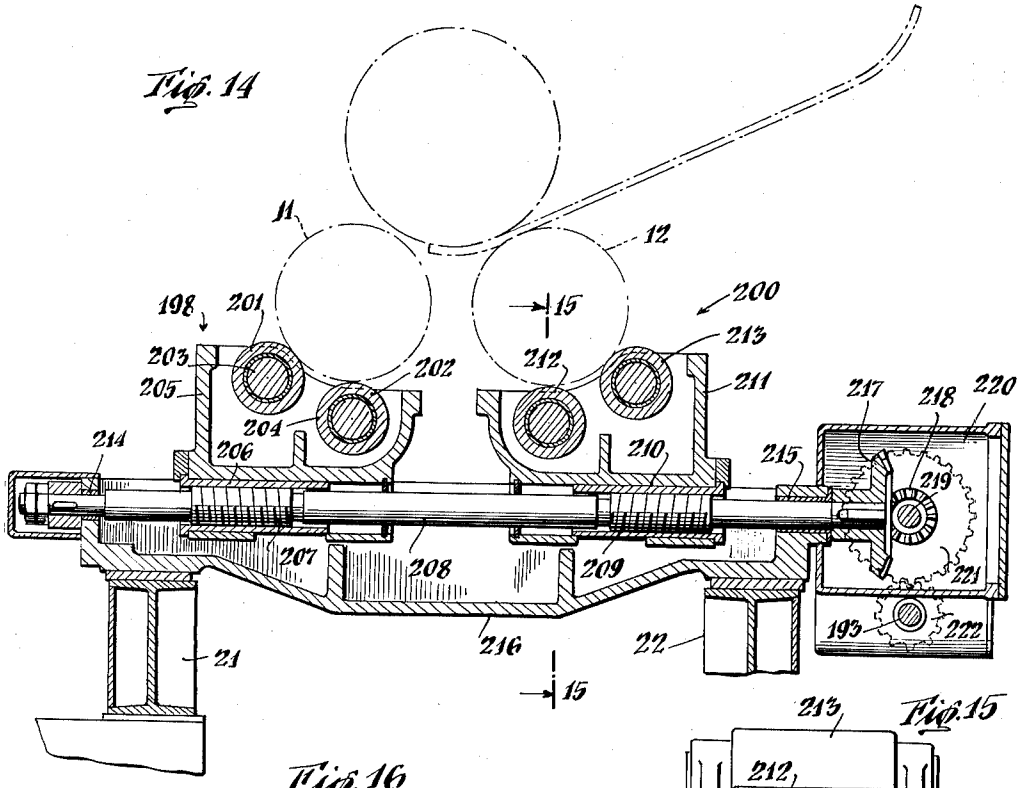


Fig. 16

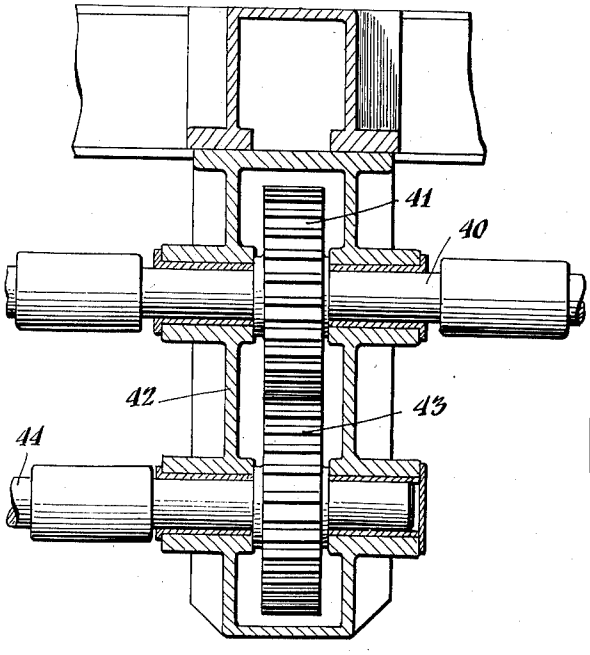
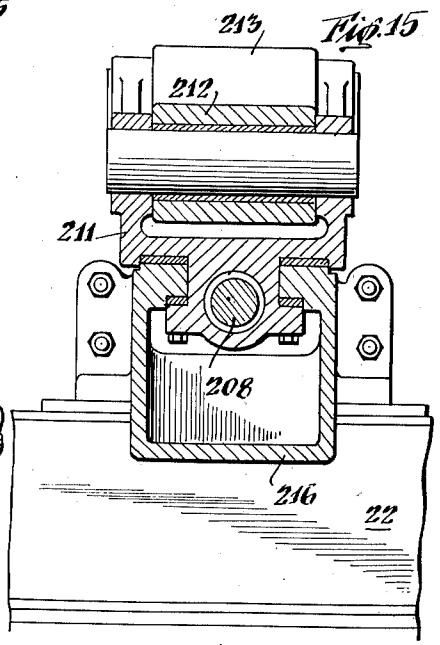


Fig. 15



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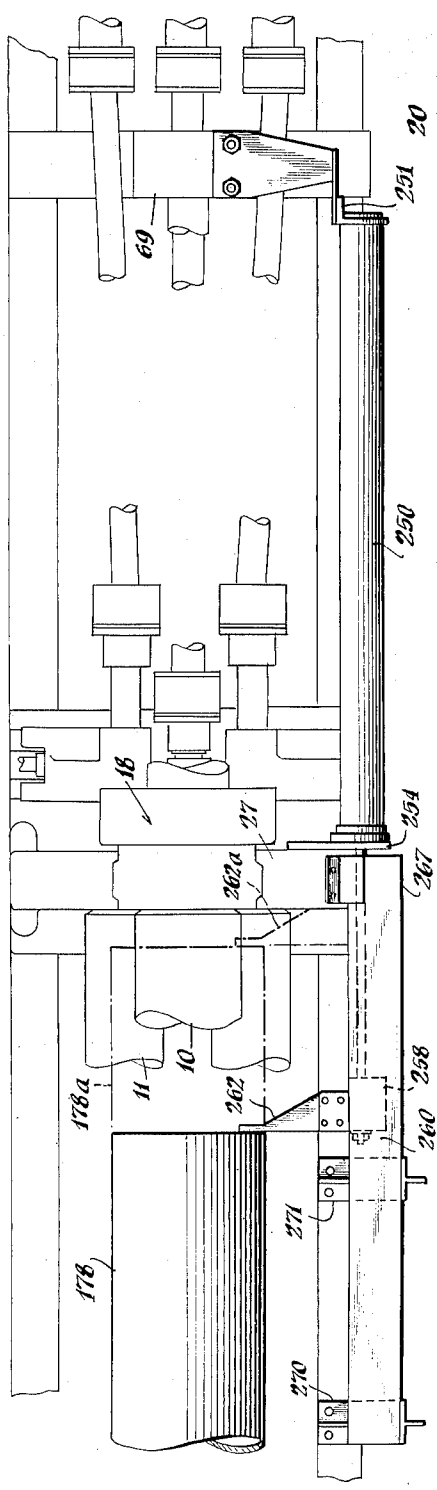


Fig. 17

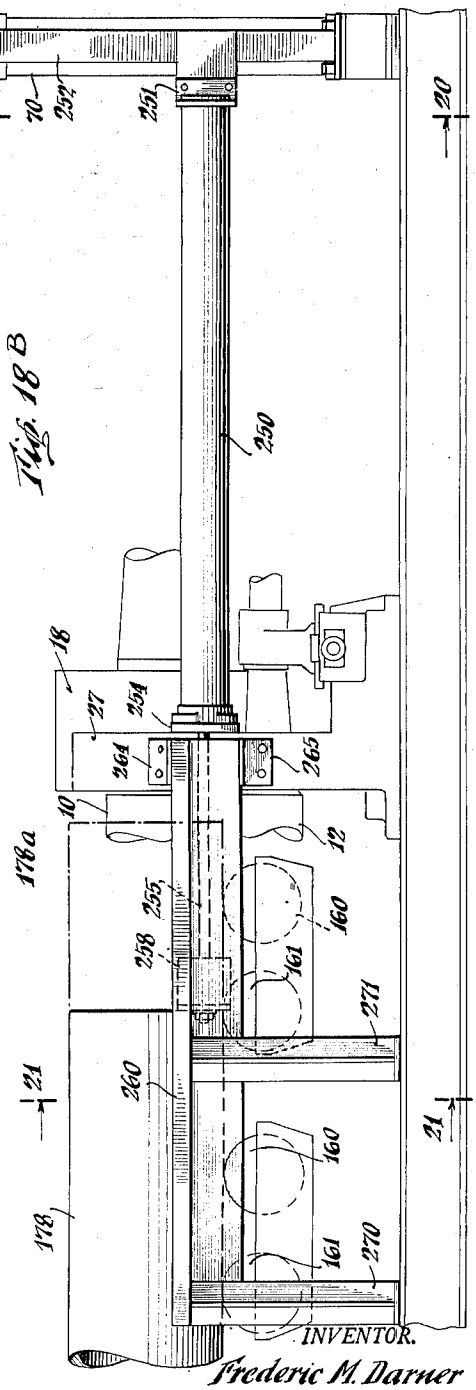


Fig. 18B

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Filed June 14, 1949 11 Sheets-Sheet 10

Fig. 18A

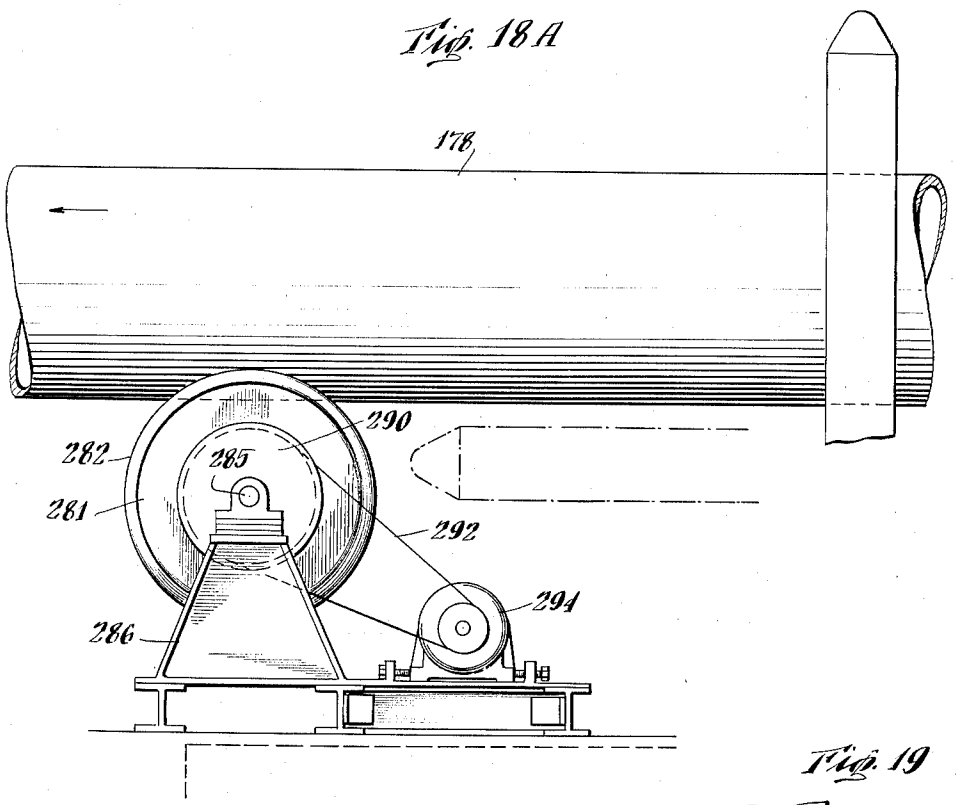


Fig. 19

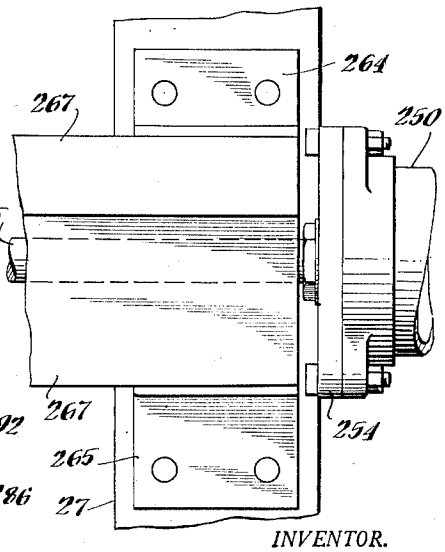
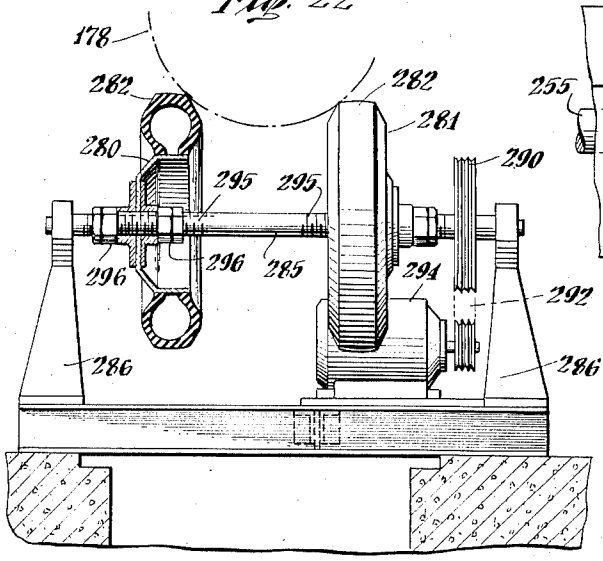


Fig. 22



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March 4, 1952 F. M. DARNER 2,587,975

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Filed June 14, 1949 11 Sheets-Sheet 11

Fig. 20

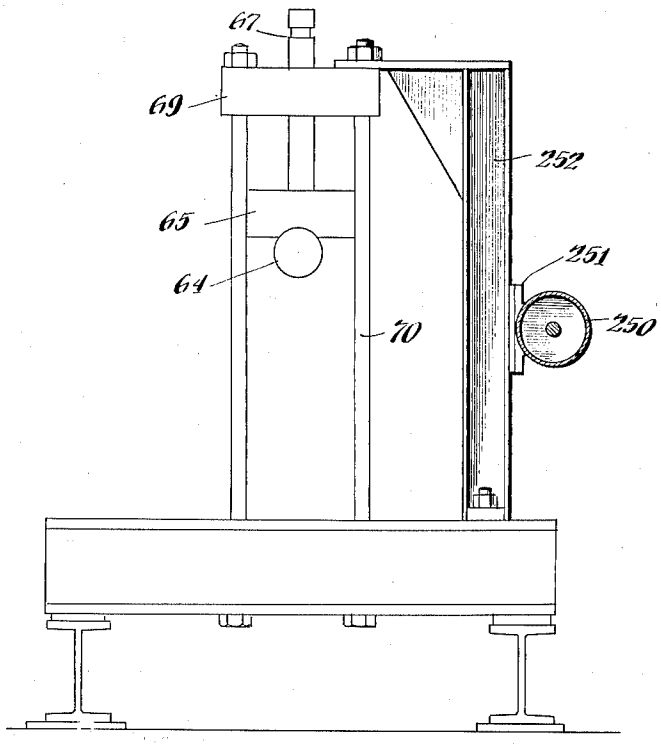
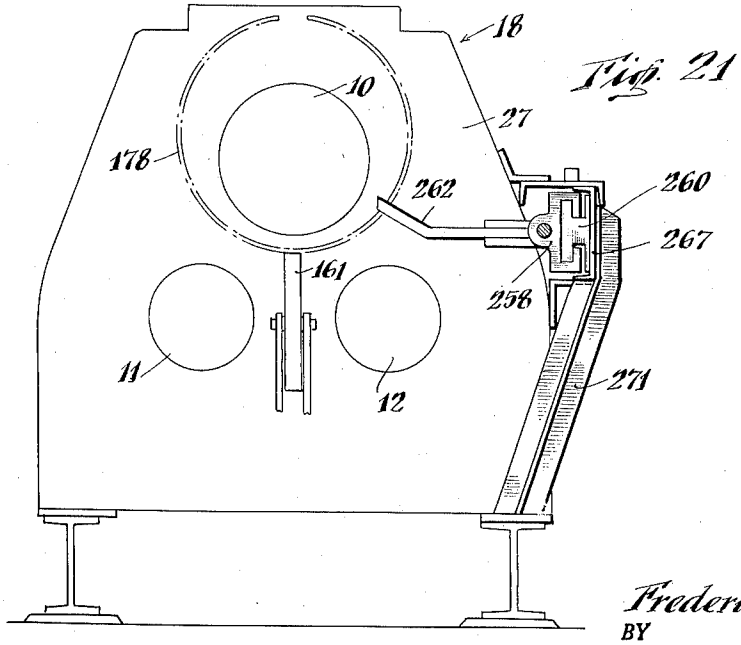


Fig. 21



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Patented Mar. 4, 1952

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UNITED STATES PATENT OFFICE

2,587,975

APPARATUS FOR FORMING CYLINDRICAL SHAPES

Frederic M. Darner, Shaker Heights, Ohio, assignor to Republic Steel Corporation, Cleveland, Ohio, a corporation of New Jersey

Application June 14, 1949, Serial No. 99,102

11 Claims. (Cl. 153—54)

1

This invention relates to apparatus for forming cylindrical shapes. The apparatus includes three parallel rolls which are mounted in spaced relationship with respect to each other during a rolling operation. The rolls are arranged with two of the rolls lying in a horizontal plane and spaced from each other, and a third roll located above the two lower rolls and centrally with respect thereto. All three of the rolls are power-driven during a rolling operation. The bearings of the upper roll are vertically movable and the vertical movement of the upper roll is attained by the application of power to the supports for the bearings of the roll. The distance between the two lower rolls is adjustable to accommodate the apparatus for rolling shapes to different diameters.

When the spacing of the lower rolls has been adjusted, a sheet of metal whose longitudinal edges have been suitably curled is inserted above the two lower rolls and beneath the upper roll, and the upper roll is lowered sufficiently to engage the sheet between the upper roll and the two lower rolls. The set position of the upper roll is dependent upon the diameter of the rolled shape which is to be formed. When the sheet of metal is gripped, the rolls are operated and the sheet is rolled into a cylindrical shape formed outside of the upper roll.

The two lower rolls are of the same diameter and the upper roll has a greater diameter. Backing-up rolls are employed for preventing bowing of the two lower rolls. These backing-up rolls are adjustable, together with the lower rolls, for changing the spacing between the lower rolls.

After the cylindrical shape has been formed, the upper roll is raised sufficiently to relieve the pressure exerted thereby upon the rolled shape and the shape is then removed from one end of the apparatus. The bearing for the upper roll adjacent one end of the apparatus is removable from supporting relationship to the upper roll. When this bearing has been displaced, the formed shape may be taken from the upper roll. The other end of the upper roll projects through its bearing and means are provided for engaging the projecting end to prevent tilting of the upper roll when the removable bearing has been displaced. The apparatus includes motor-controlled means for rapidly raising the two bearings of the upper roll and for lowering the upper roll into gripping relation with a plate to be rolled at a lower speed.

The apparatus includes power-driven wheels

2

for facilitating the removal of a rolled shape from the apparatus. These wheels are mounted on a carriage located between the pair of lower rolls and displaceable vertically for engaging the wheels with the bottom of the rolled shape. The carriage is raised by hydraulic jacks until the wheels engage and lift the shape from contact with the lower rolls. This is accomplished after the upper roll has been raised and the displaceable end bearing has been lowered. The wheels on the carriage are then motor-driven and the tube which rests upon the wheels is conveyed from the end of the upper roll.

The apparatus may in addition include a fluid-pressure-actuated ejector which positively engages the inner end of the rolled shape and displaces the shape endwise while it rests on the elevated wheels of the carriage. When the ejector is used alternatively to the motor drive of the wheels, the latter may be permitted to idle and constitute a rolling pathway for the tube. The opposite, outer end of the tube which is thus advanced by the ejector is then received by a pair of driven, rubber-tired rollers, which take over the transport of the tube and complete its endwise removal from the apparatus.

The apparatus is suitable for forming tubes from relatively heavy sheets of medium carbon steel, and all of the parts of the apparatus are preferably motor-operated.

The objects of the invention include the provision of an apparatus having the structural characteristics and a mode of operation substantially as set forth in the foregoing brief description and as illustrated in the accompanying drawings which show the best mode which has been contemplated for utilizing the principle of the invention.

In the drawings:

Figs. 1A and 1B illustrate a plan of the apparatus;

Figs. 2A and 2B illustrate a side elevation of the apparatus;

Fig. 3 is an elevational view through one of the bearings of the upper roll on line 3—3 of Fig. 2A;

Fig. 4 is a sectional view on line 4—4 of Fig. 3;

Fig. 5 is an elevational view through the displaceable bearing of the upper roll on line 5—5 of Fig. 2B;

Fig. 6 is a section on line 6—6 of Fig. 5;

Fig. 7 is a plan showing the displaceable bearing in lowered position;

Fig. 8 is a section on line 8—8 of Fig. 6 and illustrating the horizontal displaceable bearings on the lower rolls;

Fig. 9 is a section on line 9—9 of Fig. 6 showing the worm drive for the upper roll-bearing elevating mechanism;

Fig. 10 is an elevational view of the mechanism for elevating and removing the rolled shape;

Fig. 11 is a longitudinal sectional view of one end of the mechanism shown in Fig. 10;

Fig. 12 is a section on line 12—12 of Fig. 11;

Fig. 13 is a section on line 13—13 of Fig. 11;

Fig. 14 is a section on line 14—14 of Fig. 1B;

Fig. 15 is a section on line 15—15 of Fig. 14;

Fig. 16 illustrates the gearing between the power-driven shaft and the shaft by which power is transmitted to raise and lower the upper roll;

Fig. 17 is a plan of part of the apparatus, showing the cooperating ejector device;

Figs. 18A and 18B are elevations representing in effect a single view with part broken away between them, Fig. 18B showing the structure of Fig. 17 and Fig. 18A showing structure, disposed beyond the left-hand end of Fig. 18B, for cooperatively receiving the rolled shape;

Fig. 19 is a fragmentary detail view of a part of Fig. 18B, greatly enlarged;

Figs. 20 and 21 are enlarged sections respectively on lines 20—20 and 21—21 of Fig. 18B; and

Fig. 22 is an end elevation of the device of Fig. 18A, enlarged, and partly in vertical section.

The shape-rolling rolls of the apparatus consist of an upper roll 10 and two lower rolls 11 and 12. These rolls are parallel to each other with the lower rolls lying in a horizontal plane, and the upper roll located thereabove and equally spaced from the lower rolls. The operating relationship of the rolls is illustrated in Figs. 1A, 1B, 2A, 2B, 12 and 14.

The ends of the lower roll 11 are mounted in bearings 13 and 14 and similar bearings 15 and 16 are provided for the lower roll 12. The bearings 13 and 15 at one end of the apparatus are slidably mounted on ways 17 (Fig. 4), located at the upper surface of a laterally extending sill portion 18a of the inner housing assembly 18 for the rolls, and the bearings 14 and 16 are similarly supported on ways 19 on a laterally extending sill portion 20a of the outer housing assemby generally designated 20, at the other end of the apparatus (Figs. 7 and 8). The housing assemblies 18 and 20, including their sill portions 18a and 20a, are supported by beams 21 and 22 which extend longitudinally of and support the apparatus. The beams 21 and 22 are supported by foundations 23 and 24, respectively, which flank the sides of a pit 26 into which parts of the operating mechanism extend, Figs. 3 and 5.

Referring to Figs. 3 and 4, the inner housing 18 includes upwardly extending members 27 providing guideways 28 and 29 which are engaged by guides 30 and 31 at opposite edges of a yoke 32 in which the bearing shells 33 and 34 for one end of the upper roll 10 are mounted. The yoke 32 carries a removable bearing block 35 which retains the bearing shell 33. The upper surface of the bearing block 35 is seated against a transverse pin 36 as shown (Figs. 3 and 4), permitting the bearing and thus the end of the roll 10 to rock slightly on a transverse axis to accommodate the slight bending of the upper roll which occurs when the latter is placed under pressure for the forming operation. There is sufficient pitch-line clearance in the driving gears, described below, to permit this slight motion of the end of the roll.

The yoke 32 is movable vertically for raising and lowering the end of the upper roll 10. For this purpose the yoke 32 is mounted on the upper end of a rod 37 whose lower end is threaded and engaged by a nut whose rotation causes longitudinal movement of the rod 37. The nut is keyed to a worm wheel which is enclosed in the casing 39. This elevating mechanism will be described in more detail with reference to the bearing supporting the other end of the roll 10 (see Figs. 5 and 6). The elevating nut is rotatable by the shaft 40, Figs. 3 and 4, which is supported in suitable bearings in the casing 39 and along its length. The shaft extends to the other end of the apparatus (Figs. 2A and 2B). The shaft 40 carries a gear 41 (Fig. 16) which is contained within a gear box 42. The gear 41 is engaged by a gear 43 mounted on a shaft 44 which is operable by a motor 45 through a change speed mechanism 46 of conventional design (Fig. 2A). The change speed mechanism is operable for enabling a rapid elevating movement of the roll 10 and a slower depressing movement of the roll 10, for example, as when a plate is being initially engaged by the rolls before the rolls are rotated.

The yoke 32 also provides bearings 48 and 49 for a shaft 50 which carries a gear 51 by which the gear 52, keyed to the upper roll 10, is driven. The end of the shaft 50 is connected to a shaft 53 by a universal joint 54, and the other end of the shaft 53 is connected to a drive shaft 55 by a universal joint 56. The motor 57 operates the shaft 55 through a speed reduction unit 58. The lower rolls 11 and 12 are also driven from the speed reduction unit 58 through the shafts 59 and 60 and the shafts 61 and 62, respectively, which are suitably connected by universal joints to the lower rolls 11 and 12. All of the universal joints permit relative axial movement between their inner and outer engaging parts for enabling changes in the positions of the axes of the rolls 10, 11 and 12 with respect to the axes of the driving shafts 55, 59 and 60. The shafts 55, 59 and 60 are driven at such speeds that the velocity of the surfaces of all three of the rolls 10, 11 and 12 is the same.

The end of the shaft of the roll 10 extends beyond the gear 52 into a tapered projection 63, Figs. 1A and 2A, which terminates in a cylindrical end 64 which is adapted to be engaged by a block 65 for supporting the roll 10 when the bearing of the roll at the other end of the apparatus is removed. The block 65 is carried by a screw 67 which is engaged and supported in a tapped hole in a plate 68. The plate 68 is fastened to a beam 69 which is supported by and fastened to four rods 70. The lower ends of the rods 70 are fastened to a cross-beam 71 which is supported on the longitudinal beams 21 and 22. The deflection of these beams is prevented by anchor bolts 72 which project from the foundation.

When the apparatus is actually rolling a shape the cylindrical end 64 is disposed some distance below the block 65, out of contact therewith. When a rolling operation has been completed and it is desired to remove the formal shape, the top roll 10 is raised by the yoke 32 and another yoke (hereinbelow described) at the outer end of the roll, until the cylindrical end 64 comes in contact with the block 65, which has been originally set at a predetermined elevation. Thus while the formed shape is being removed, the top roll 10 is held in its elevated position by the yoke 32, and by the block 65, under and against which

the cylindrical end 64 is now seated. The block 65, by keeping the projection 63 from rising, thus securely opposes the gravitational effort of the heavy body of the roll 10 (now unsupported at its outer end) to rock downward about the bearing 34 as a fulcrum.

The formed shape is removable from the end of the apparatus which is illustrated in Figs. 1B, 2B, 5, 6 and 7. When the rolls are being rotated to form a shape the roll 10 is laterally stabilized by an outer housing 73 which is supported on the shafts 74 and 75 to which it is keyed. The shaft 74 is rotatable in bearing bosses 76 and 77 and the shaft 75 is rotatable in bearing bosses 78 and 79. These bearing bosses project upwardly from a laterally extending block 20 which rests upon and is anchored to the longitudinal beams 21 and 22. A gear sector 81 is keyed to the shaft 74 and a gear sector 82 is keyed to the shaft 75, and these two gear sectors are rocked to rock the shafts 74 and 75 to move the housing 73 between its upright position, Fig. 6, and a lowered position (Fig. 7).

The gear sectors 81 and 82 are engaged by the gear sectors 83 and 84, respectively, which are keyed to a shaft 85. The shaft 85 is mounted for rotation in bearings within the brackets 86 and 87 which project from the block 20. The shaft 85 is rocked to lower and raise the housing 73. The power for accomplishing this is applied through an hydraulic cylinder 88, a piston rod 89, and a pivotally connected slide 90 (Figs. 6 and 7). The slide 90 is guided by a bar 91 attached to the laterally extending block 20. The gear sector 83 carries an arm 92 which is pivotally connected to the slide 90 by a link 93. As the slide 90 is moved to the right, as seen in Fig. 2B, the housing 73 is rotated downwardly toward the position illustrated in Fig. 7, and the reverse movement of the slide raises the housing to its upright position as illustrated in Fig. 1B.

The end of the roll 10 which may be relieved of support, is supported during a sheet rolling operation by a ring or yoke 94 which is adapted to slide with respect to the housing 73. The end of the roll 10 has a turned down shaft 95 which is engaged by a bearing member 96. This bearing member is closed at its end for providing an oil reservoir and for the exclusion of dirt. The bearing member 96 is carried by and fitted within a ring 97 which has an exterior annular bearing surface 98 concentric throughout its width with the axis of the shafts 74 and 75. This bearing surface 98 is engaged by a complementary annular bearing surface on the inside of the supporting ring 94. The supporting ring 94 carries bosses 100 and 101 to which sliding blocks 102 are pivotally mounted. The opposite edges of these blocks are parallel and are engaged by ways 103 and 104 extending from the inner vertical surfaces of the housing 73. The end shaft 95, ring 97 and supporting ring 94 are guided for linear movement with respect to the housing 73.

The supporting ring or yoke 94 has extending from its under side a pair of arms 106 and 107 which have bosses 108 and 109, respectively, at their lower ends. These bosses are bored to engage a shaft 110 which passes through the head 111 of a vertically guided rod 112. The lower end 113 of the rod 112 is threaded and engaged by a rotatable nut 114. The nut 114 is journalled for rotation and is supported by a thrust bearing 115. The worm wheel 116 is carried by the nut and is engaged by a worm 117 (Figs. 5 and 9), which is keyed to the shaft 40. The worm and worm wheel 116 are enclosed within a box 118 by which the thrust bearing 115 is supported. The gear box 118 and thrust bearing 115 are supported by four rods 119, 120, 121 and 122 which depend from the sill portion or cross-beam structure 20a of the housing assembly 20. The shaft 40, which has previously been referred to with reference to the elevating control of the other end of the roll 10 is operated from the shaft 44. The roll-supporting and elevating rods 37 and 112 are operated simultaneously through similar worms and worm wheels by the shaft 40.

Before the supporting ring 94 is removed from the end of the roll top 10 by lowering the housing 73, the tail end 64 of the roll has been engaged by the block 65 as described above, so that the roll remains in its elevated position. The formed shape may then be removed. Since the apparatus is designed for forming a tube from relatively heavy stock, it is desirable to relieve the lower rolls 11 and 12 from supporting the tube when the tube is withdrawn from the roll 10. A carrier mechanism 123, as illustrated in Figs. 10 to 13, inclusive, is provided for that purpose. The carrier mechanism includes a carriage which is vertically movable to lift the tube from the lower rolls after the upper roll has been raised from engaging relationship with the interior of the tube.

The carriage is located between the lower rolls 11 and 12 and centrally below the upper roll 10. The carriage includes a central beam 124 rigidly connecting with similar rectangular frames 125 and 126 at its ends. The frames 125 and 126 are supported by hydraulic jacks 127 and 128, respectively. Each jack includes a movable cylinder 129 (Figs. 11 and 12) in operating engagement with a piston 130 which is attached to a cross-piece 131 extending between and supported by the longitudinally extending beams 21 and 22. The upper end of the cylinder 129 fits in the socket of a barrel 132 whose lower rim abuts a flange 133 projecting from the exterior of the cylinder. The barrel is supported on the cylinder and is movable therewith when the interior of the cylinder is pressurized.

The cylinder 129 and barrel 132 are guided for vertical movement by guideways 134 and 135 carried by the brackets 136 and 137, respectively, which extend upwardly from the cross-piece 131. The barrel 132 carries lugs 138 and 139 to which the upper ends of rods 140 and 141, respectively, are secured. The lower ends of these rods extend below the cross-piece 131 and are provided with stop members 142 and 143 whereby to limit the extent of upward movement of the cylinder 129 and of the carriage 123. Pressure is applied to the interior of the cylinder 129 through a hole drilled through the axis of the piston 130. The two jacks 127 and 128 are similarly constructed and associated with their respective ends of the carriage 123 and they are simultaneously operable through connected pressure lines whereby the same pressure is available for operating them.

Each rectangular frame 125 and 126 has fastened to it two pairs of parallel side plates which serve to support wheels and operating motors by which the wheels are driven. As illustrated in Fig. 11, the side plates 150 and 151 are located at one side of the jack, and the side plates 152 and 153 are located at the other side of the jack. The sets of wheels and wheel-operating motors at both sides of the jack are similarly supported.

A shaft 154 is journalled in the plates 150 and 151, Figs. 11 and 13. A horizontal plate 155 is secured to the lower edges of the plates 150 and 151, and a motor 156 is supported therefrom. This motor 156 drives a sprocket and gear connection 157 by which the shaft 154 is rotated. A roller 158 is keyed to the shaft 154 and this roller frictionally engages an idler wheel 159 which in turn frictionally engages the wheels 160 and 161. The idler wheel 159 is held over the roller 158 by a pair of radius links 162 and 163 which are pivotally connected at one end to the shaft 164 of the idler wheel 159 and at their other end to a shaft 165 which is supported by the side plates 150 and 151.

The two wheels 160 and 161, rotatable on shafts 166 and 167, respectively, are carried by opposite walls of a four-walled auxiliary carriage 168. This auxiliary carriage 168 is supported by the idler wheel 159 and the shaft 154, but it is free to float as determined by the contacting relationship between the idler wheel 159 and the two wheels 160 and 161, and to tilt on the roller 158. The wheels 159, 160 and 161 have rubber rims, and the carriage 168 is therefore resiliently supported. The carriage has a plurality of elongated openings 169 and 170, Fig. 11, which are engaged by the rods 171 and 172 which extend between the plates 150 and 151 and cooperate with the openings for limiting its tiltable movement on the line of contact between the supporting roller 158 and the idler wheel 159.

Each of the auxiliary carriages 168, 173, 174 and 175 is similarly constructed and mounted so that all of the wheels carried thereby and which are engageable to contact with the bottom of a cylindrical shape function similarly. Each of the four pairs of wheels is driven by an individual motor and all of the motors are operable together to actuate the wheels simultaneously and at the same speed. An idler wheel 176 is mounted on a shaft 177 located midway on the beam 124 centrally of the auxiliary carriages at either end of the beam. The wheel 176 serves to support the formed shape particularly when its following end has left the wheels mounted in the auxiliary carriages 174 and 175.

When the roll 10 has been raised to an elevated position 10*a* (Fig. 12) by the roll-elevating mechanisms, and the housing 73 is depressed to leave the end of the roll free, the rolled shape 178 may be removed from the apparatus. It is lifted to a position 178*a* above the rolls 11 and 12 by operating the jacks 127 and 128 and thereby raising the carrier mechanism 123. The wheels of the carrier mechanism are brought into contact with the bottom of the shape 178 and the shape is lifted clear of the rolls 11 and 12. Thereafter the motors 156 are operated to drive the wheels and convey the shape from the apparatus.

As previously explained, the rolls 11 and 12 are independently mounted at their ends in bearings which are movable cross-wise of the apparatus to adjust the spacing between the rolls. The bearings for these rolls are similarly constructed at both ends of the apparatus. As illustrated in Figs. 6, 7 and 8, the bearings 14 and 16 are mounted on two laterally movable carriages 180 and 181, respectively. These carriages slide on ways 19 at the upper surface of the laterally-extending sill portion 20*a*. The shaft 182 extends through the carriages 180 and 181 and is rotatably supported in bearings 183 and 184 which are carried by the sill portion 20*a*. The carriages 180 and 181 have fixed thereto nuts 185 and 186 which

are engaged by left and right-hand threads 187 and 188, respectively, on the shaft 182. Depending upon the direction of rotation of shaft 182, the bearings 14 and 16 will be caused to move towards or away from each other simultaneously. One end of the shaft 182 carries a gear 189 which meshes with a gear 190 to which a bevel gear 191 is keyed. The bevel gear 191 meshes with a bevel gear 192 on the shaft 193 which extends lengthwise of the apparatus (Fig. 7). This shaft extends for the full length of the apparatus and operates a cross-shaft 194 (Fig. 1A) which simultaneously moves the bearings 13 and 15 at the other ends of the rolls 11 and 12. The shaft 193 is driven from a motor 195 (Fig. 1B) through gears contained in the gearing box 196.

Because of the lengths of the rolls 11 and 12, it is desirable to provide backing-up rolls which will support the rolls 11 and 12 intermediate their lengths during a rolling operation. In the apparatus illustrated in the drawings there are two sets of backing-up rolls 197 and 198 for the roll 11, and two sets of backing-up rolls 199 and 200 for the roll 12, Figs. 1A and 1B. A section through the backing-up rolls 198 and 200 is illustrated in Fig. 14. As may be seen in this figure, the roll 11 is in contact with two rolls 201 and 202 which are freely rotatable on shafts 203 and 204, respectively. The shafts are mounted in a laterally-movable carriage 205. The lateral position of the carriage is controlled by a nut 206 which is engaged by a threaded portion 207 of a shaft 208. An oppositely threaded shaft portion 209 is engaged by a nut 210 which is carried by the carriage 211 on which the rolls 212 and 213 which back up the roll 12 are mounted.

The shaft 208 is journalled in bearings 214 and 215 supported by the cross-beam 216. The shaft carries the bevel gear 217 which meshes with a bevel gear 218 on the shaft 219. The shaft 219 is journalled in a gear box 220 and has keyed to it a gear 221. The gear 221 is engaged by a gear 222 on shaft 193.

The backing-up rolls 197 and 199 are similarly controlled through a cross-shaft 223 and gearing contained in the gear box 224, Fig. 1A. The gearing connections between the shaft 193 and the various cross-shafts 182, 208, 223 and 194 by which the end bearings of the lower rolls 11 and 12 and the backing-up rolls are positioned are such that the bearings and the backing-up rolls will be moved like distances when adjustment of the spacing of the rolls 11 and 12 is desired.

Figs. 17 to 22 inclusive, show further structure cooperatively useful with the apparatus described above, and including an ejector device which may be employed for positively displacing the rolled shape, instead, for example, of relying upon motor drive for the wheels 160, 161 of the carriage.

Referring to these figures, a suitably controlled, double-acting, fluid-pressure-actuated cylinder 250, for example, a cylinder containing a suitable piston (not shown) adapted to be driven in either direction by air under pressure, is mounted in a horizontal position, one end of the cylinder being carried by a bracket 251 on a column 252 appropriately secured to the upright structure 69, 70 at one side thereof. The forward end of the cylinder is carried on an adaptor plate 254 mounted on an upright part 27 of the inner housing 18. The piston rod 255 of the cylinder, which is driven axially in either direction as explained above, is adapted to project along-

side of the rolls 10, 12, and carries at its end a slide 258 which rides on horizontally disposed and vertically spaced ways 260, conveniently constituted by a rigid guide member as shown, having upper and lower channels into which the arms of the slide project.

The slide 258 carries a laterally projecting, ejector dog 262 which extends to a point near the surface of the roll 10 so that the end of the dog 262 can abut the end of the rolled shape 178. It will be noted that the rolled shape has its end somewhat spaced from the housing 27, as shown by dot-and-dash lines 178a, allowing space for the ejector dog 262 when the latter is at its righthand position (Fig. 17) and while the rolls are operating to form the shape 178. The guide or way structure 260, which extends horizontally alongside of the rolls is supported at one end, next to the cylinder 250, by brackets 264, 265 fastened on the housing 18 and secured to an elongated, channel shaped supporting and protecting structure 267 within which the guide structure 260 is secured. At further localities the guide structure 260 is carried on angularly disposed columns 270, 271 projecting from a supporting beam of the apparatus.

The cylinder and its piston rod are selected to have an appropriate length of stroke, which may be considerably less than the length of the rolled shape 178. In one embodiment, where the latter was about 30 feet long, an air cylinder having a stroke of 9 feet, and providing a corresponding length of stroke for the slide 258 and the dog 262, was found satisfactory. It will now be seen that the piston rod is kept in its retracted position during the rolling operation, the dog 262 being disposed between the righthand (inner) end of the plate or skelp which is being rolled, and the inner housing 18, i. e., as indicated by dot-and-dash lines 262a in Fig. 17. When the rolling operation is completed the top roll 10 is elevated and likewise the carriage 123 with its several supporting wheels including the wheels 160, 161. It may also be explained that in employing the ejector device of these figures the motor drive of the carriage wheels may be omitted, for example by removing the chains 157, so that the wheels operate as idlers, supporting the rolled shape and providing a rolling pathway for the latter.

The cylinder 250 is now actuated to drive the piston rod 255 to the left, i. e. along beside the rolls, thereby propelling the slide 258 and the ejector dog 262 toward the outer end of the apparatus. The ejector dog abuts the end of the rolled shape and positively moves the latter axially for a corresponding distance to the left (as seen in Fig. 17), for example to the end of the stroke of the piston rod.

In cooperation with the devices described above, a pair of wheels 280, 281 having rubber tires 282, which may be pneumatic tires for better grip, are mounted on a transverse shaft 285 journaled in bearings carried by spaced supports 286, at a locality somewhat to the left of the apparatus as seen in these views. Specifically the wheels are disposed under the path of the rolled shape from the apparatus, i. e. so that they receive the rolled shape as it is moved, say, to a position near the end of the path of travel of the dog 262. By a pulley 290 on the shaft 285, coupled with a belt 292 to an electric motor drive unit 294, the shaft 285 and thus the wheels 280, 281 are continuously rotated in a direction to continue the advance of the rolled shape.

As shown in Fig. 22, the shaft 285 has threaded portions 295 so that the positions of the wheels 280, 281 may be adjusted axially of the shaft, each wheel being locked in place by lock nuts 296. The wheels are not only spaced to provide good support for the rolled shape but their spacing is preferably such that they exert a pinching action on the shape between them, thereby enhancing their engagement of the tubular article and providing a more positive drive, with no likelihood of lateral displacement of the article.

Thus the ejector and further pipe conveying devices shown in Figs. 17 to 22 inclusive provide effective removal of the completed shape from the rolls, i. e. after the outer housing 73 has been lowered and while the shape is supported on the wheels 160, 161 and 176 of the now-elevated carriage. As soon as the continuously turning wheels 280, 281 take over the advance of the rolled shape, from the ejector, they then continue the removal of the shape from the rolls. The dog 262 may then be retracted to its original position, as by operation of the cylinder 250 in the reverse direction. Finally, when the inner end of the rolled shape has cleared the main apparatus, the latter may be restored to condition for a new rolling operation as explained above, i. e. by lowering the carriage 123, raising the housing 73 and lowering the top roll 10.

It will be noted that the cylinder 250 is a stall-permitting type of drive, in that driving force is continually exerted, as to overcome uneven resistance in removing the rolled shape without causing the drive to be interrupted. Furthermore when the wheels 280, 281 firmly take over the advance of the shape, by their pinching effect, the cylinder accommodates the remainder of the advance of its piston to the rate of operation of the wheels.

The principle of operation of the invention and the apparatus which is now considered to represent the best embodiments thereof, have been described, but it is desired that it be understood that the apparatus disclosed is only illustrative, and that the invention can be carried out by other means. While the apparatus illustrated in the drawings is designed to use the various features and elements in the combinations and relationships shown, some of these may be altered and others omitted without interfering with the more general results outlined, and the utility of the invention within the scope of the appended claims.

What is claimed is:

1. In an apparatus for forming cylindrical shapes, the combination comprising a pair of rolls mounted opposite each other with their axes parallel, a third roll mounted on an axis midway between and displaced from the plane of the axes of said pair of rolls, said rolls being spaced from each other for engaging a sheet of material between said third roll and each of the rolls of said pair of rolls, bearings for said rolls, means for elevating and lowering the bearings for said third roll to change the spacing between said third roll and each of the rolls of said pair of rolls, a carrier mechanism located between the rolls of said pair of rolls and beneath said third roll, and means for operating said carrier mechanism to engage a rolled shape on said third roll and raise the shape from contacting relationship with said pair of rolls.

2. The combination set forth in claim 1 in which said carrier mechanism comprises an

elongated frame carrying wheels lying in a plane passing through the axis of said third roll.

3. The combination set forth in claim 2 in which the wheels are located in pairs adjacent the ends of said carrier mechanism and said pairs of wheels are mounted in auxiliary carriages tiltable with respect to each other and each of said pair of wheels is supported by an idler and a driving roller, said driving roller being mounted on a shaft carried by said carrier mechanism, and means for rotating said shaft.

4. The combination set forth in claim 1 in which the means for elevating the carriage means comprises hydraulically-operated cylinders.

5. In an apparatus for forming cylindrical shapes, the combination comprising a pair of rolls mounted opposite each other with their axes parallel, a third roll mounted on an axis mid-way between and displaced from the plane of the axes of said pair of rolls, and said rolls being spaced from each other for engaging a sheet of material between said third roll and each of the rolls of said pair of rolls, bearings for said rolls, carrier mechanism located between the rolls of said pair of rolls and beneath said third roll, said carrier mechanism including a rigid frame, a plurality of auxiliary carriages loosely supported on said frame, a pair of wheels journalled in each of said auxiliary carriages, and means for raising said carriage to place said wheels in contact with a rolled shape on said third roll.

6. In apparatus for forming cylindrical shapes, the combination comprising a pair of rolls mounted opposite each other with their axes parallel, bearings for each roll of said pair of rolls, a third roll mounted on an axis mid-way between and displaced from the plane of the axes of said pair of rolls, said three rolls being spaced from each other for engaging a sheet of material between said third roll and each of the rolls of said pair of rolls, bearings adjacent the ends of said third roll, means displaceably supporting one of said bearings of said third roll, a projection extending from said third roll and beyond the other of said bearings for said third roll, means for engaging said projection for supporting said third roll when the displaceable bearing-supporting means is displaced from supporting relationship with said third roll, carrier mechanism located intermediate the rolls of said pair of rolls and below said third roll, means for elevating and depressing said carrier mechanism, wheels carried by said carrier mechanism, said wheels being mounted on axes lying in a plane parallel to the plane of said pair of rolls and extending perpendicular to the axes of said rolls, means for elevating said carrier mechanism to cause said wheels to engage a cylindrical shape surrounding said third roll, and means for driving said wheels to propel a rolled shape resting thereon lengthwise of said rolls to remove the shape from the end of said third roll when said displaceable bearing supporting means for said third roll is removed from supporting relationship with said third roll.

7. In apparatus for forming cylindrical shapes, in combination, forming rolls comprising a pair of laterally spaced lower rolls and an upper roll disposed centrally above said lower rolls and vertically separable from the lower rolls for removal of a rolled shape endwise over one end of the said upper roll, an ejector device disposed to engage the end of such shape at the other end of the said upper roll, means for advancing the ejector device in a direction parallel to the axes of the rolls and toward the first-mentioned end of the rolls, for pushing the shape in a direction to remove it, and roller means disposed along and between said lower rolls, said roller means being shiftable vertically to engage a rolled shape and thereby constitute a rolling pathway for supporting the shape above the lower rolls while it is pushed by the ejector device.

8. In apparatus for forming cylindrical shapes, in combination, forming rolls comprising a pair of laterally spaced lower rolls and an upper roll disposed centrally above said lower rolls and vertically separable from the lower rolls for removal of a formed shape, roller means located between said lower rolls and normally disposed below the locality of a shape being rolled by said forming rolls, said roller means being vertically displaceable for engaging a rolled shape which embraces the upper roll, to provide a rolling pathway for endwise removal of such shape, an ejector device disposed to engage an end of the shape while such shape remains in embracing relation with the upper roll and is supported by said roller means, and means for advancing said device axially of the forming rolls, to displace the rolled shape, while it is supported by the roller means, in a direction to remove the shape.

9. Apparatus as described in claim 8 wherein the means for advancing the ejector device comprise a fluid-pressure-actuated cylinder having a reciprocable piston rod driven thereby, said ejector device being mounted on said piston rod.

10. Apparatus as described in claim 8, which includes resiliently surfaced roller means disposed beyond the forming rolls in the path of travel of the rolled shape as the latter is advanced by the ejector device, said last-mentioned roller means being adapted to receive and support the shape, and means for rotating said last-mentioned roller means.

11. Apparatus as described in claim 10, wherein said last-mentioned roller means comprise a pair of resiliently-tired wheels spaced transversely of the path of the rolled shape and mounted for rotation on a similarly transverse axis, said wheels being arranged to engage an underpart of the rolled shape in pinching relation between them.

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