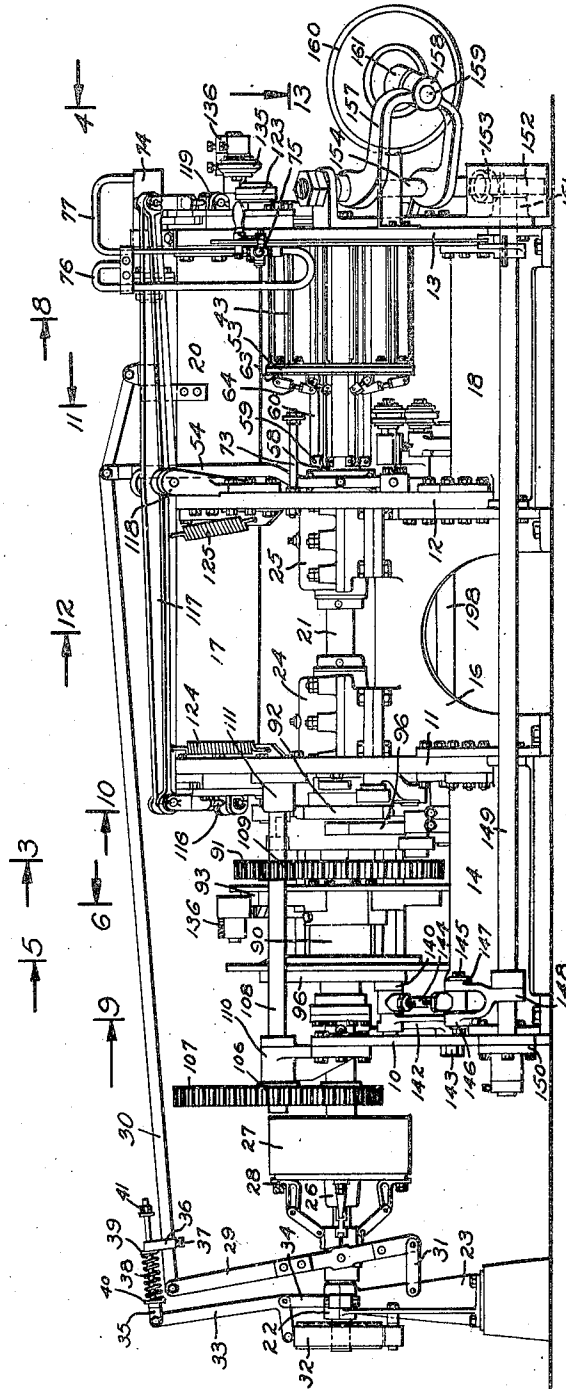
May 12, 1936. J. F. ESCH 2,040,785

DRUM MAKING MACHINE

Filed March 18, 1933 11 Sheets-Sheet 1

FIG. 1.



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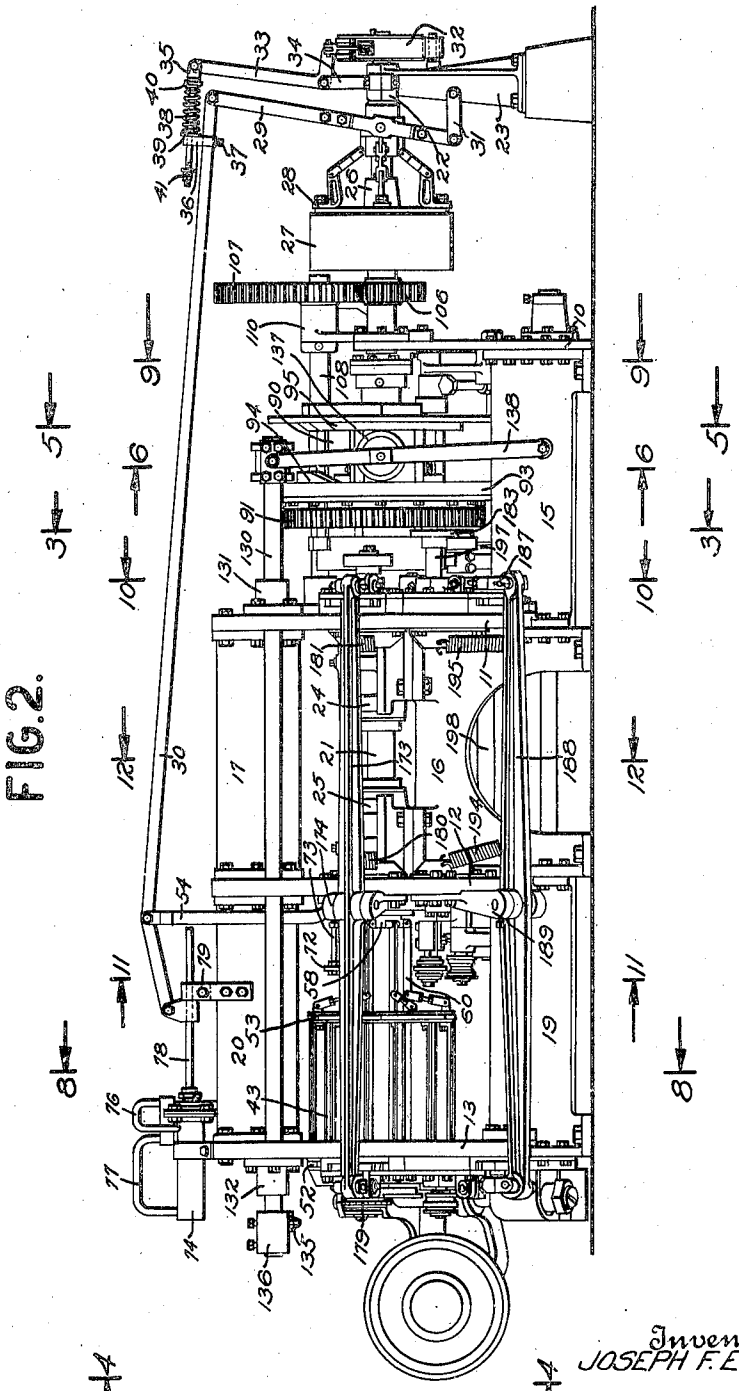

FIG. 2.

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FIG. 3.

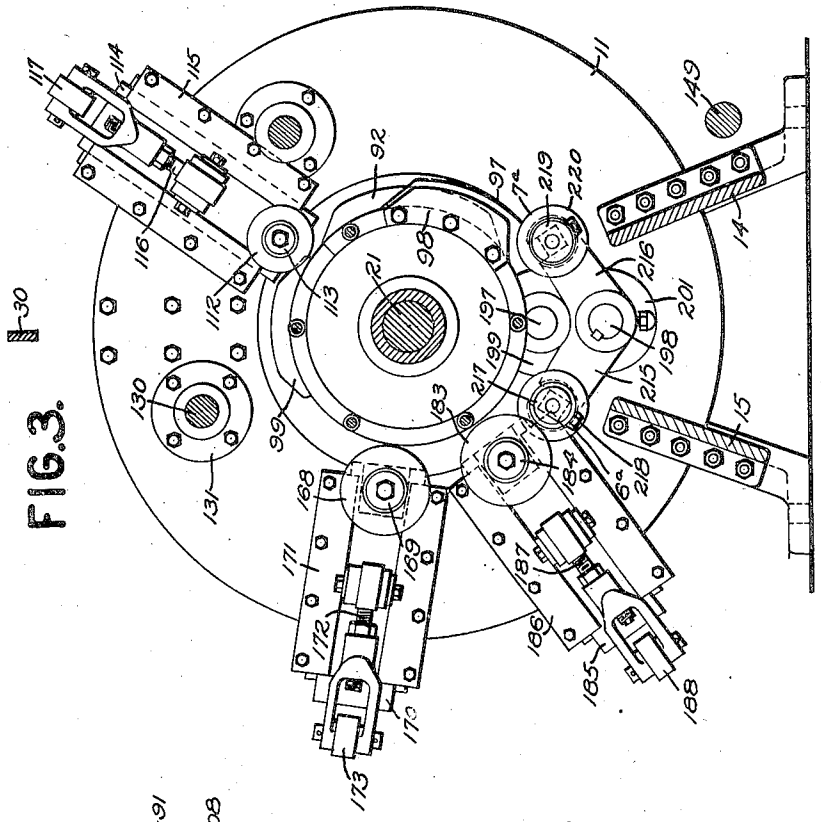
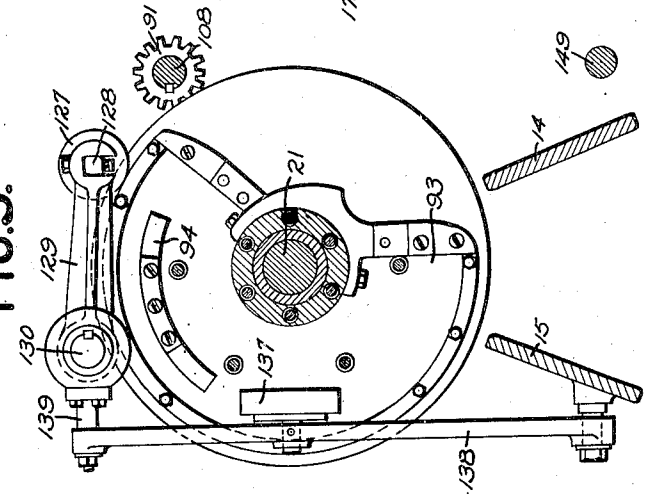


FIG. 5.



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DRUM MAKING MACHINE

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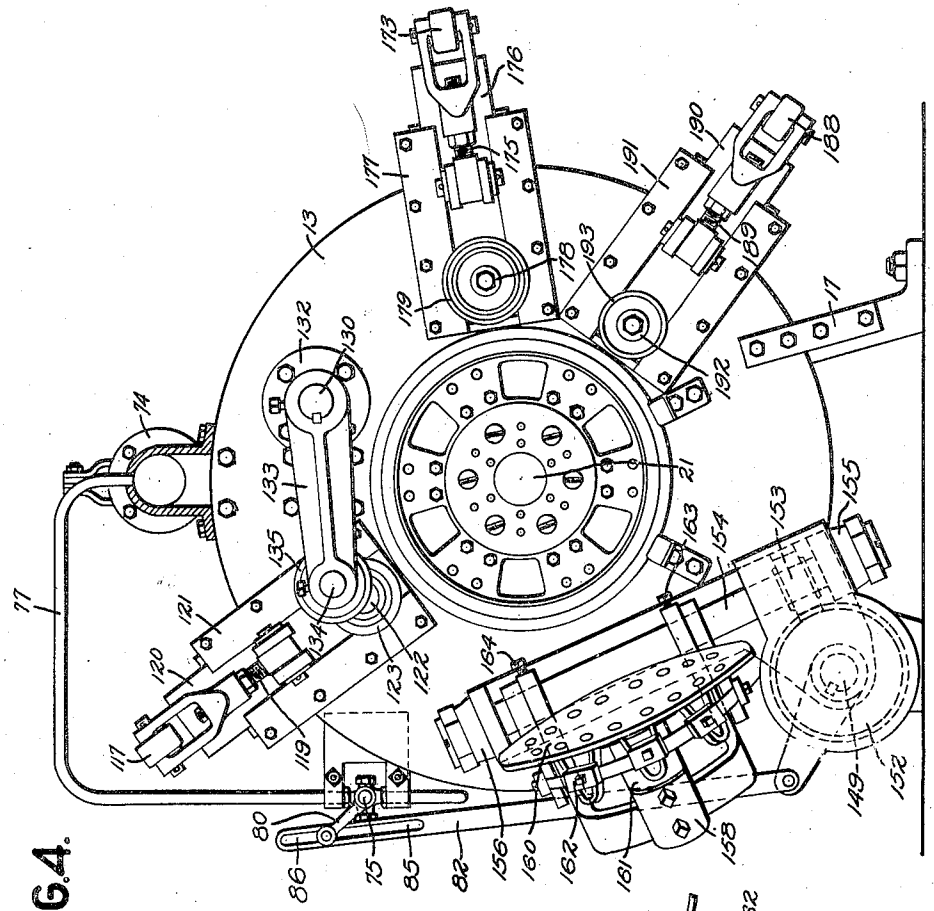

FIG.4.

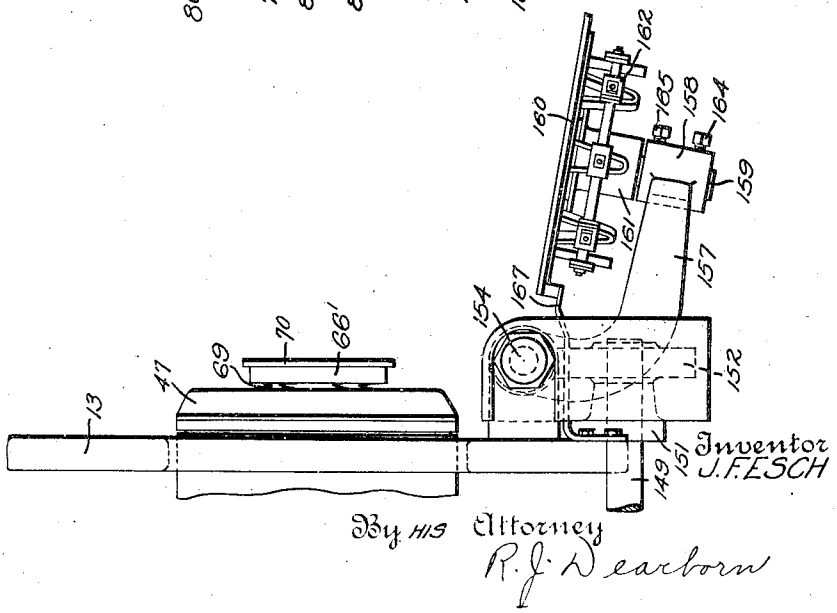

FIG.13.

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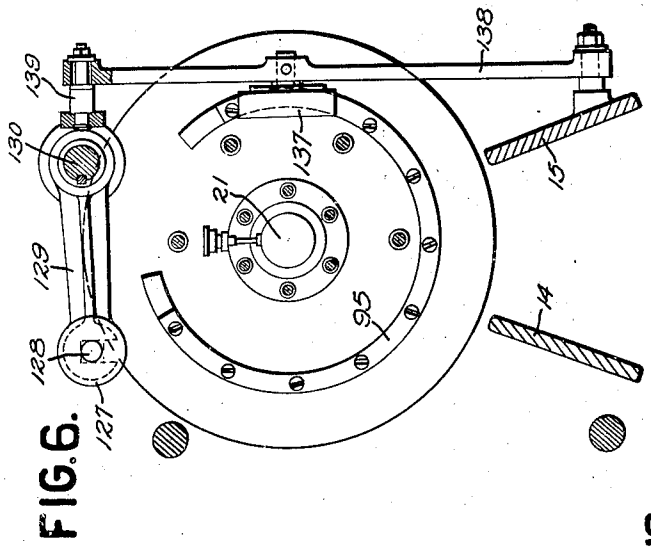

FIG. 6.

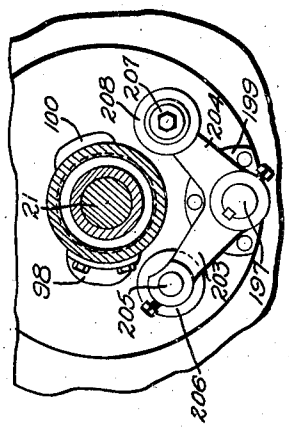

FIG. 10.

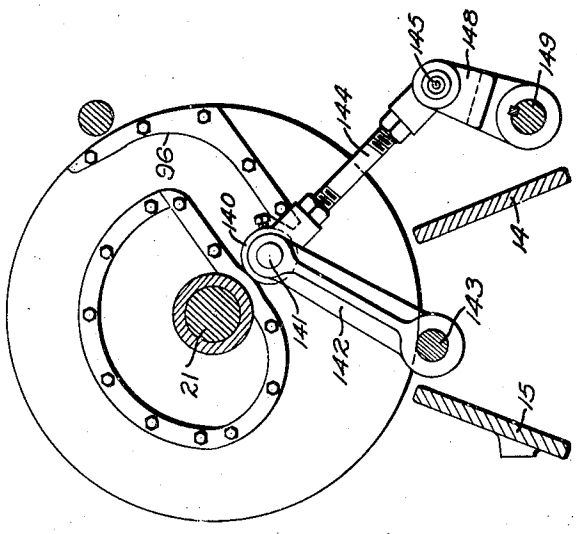

FIG. 9.

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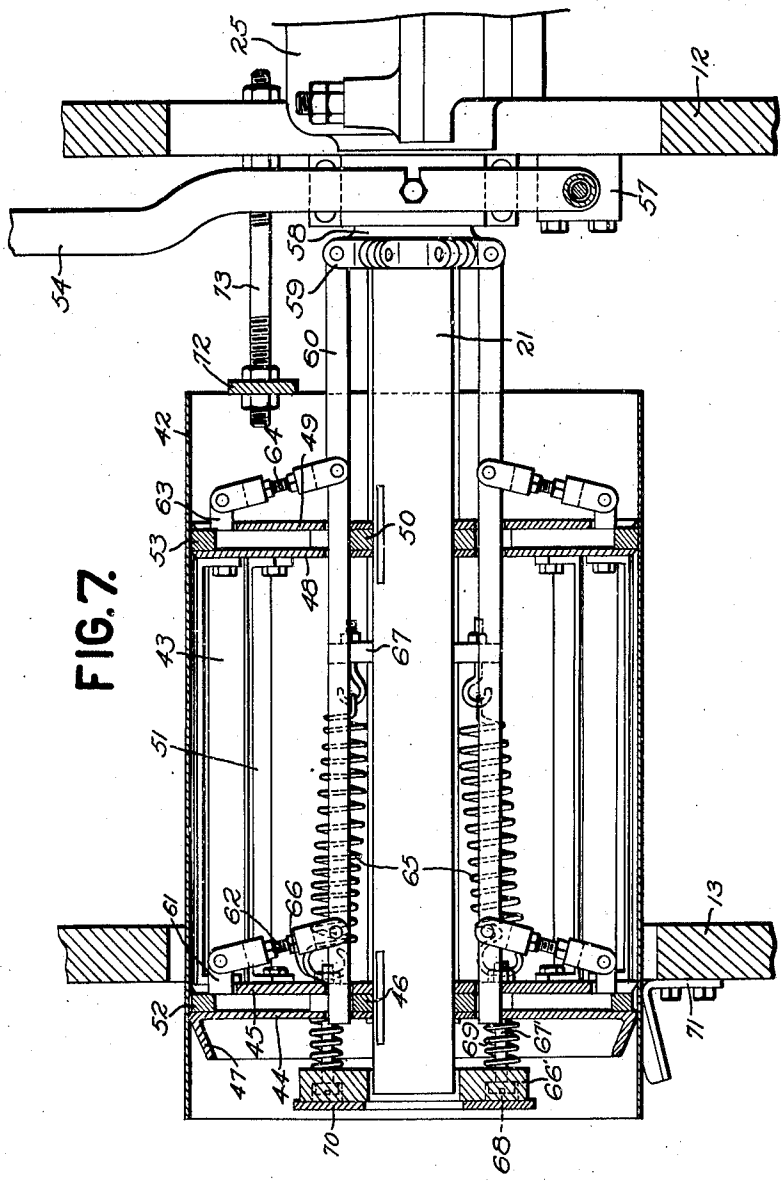
FIG. 7.



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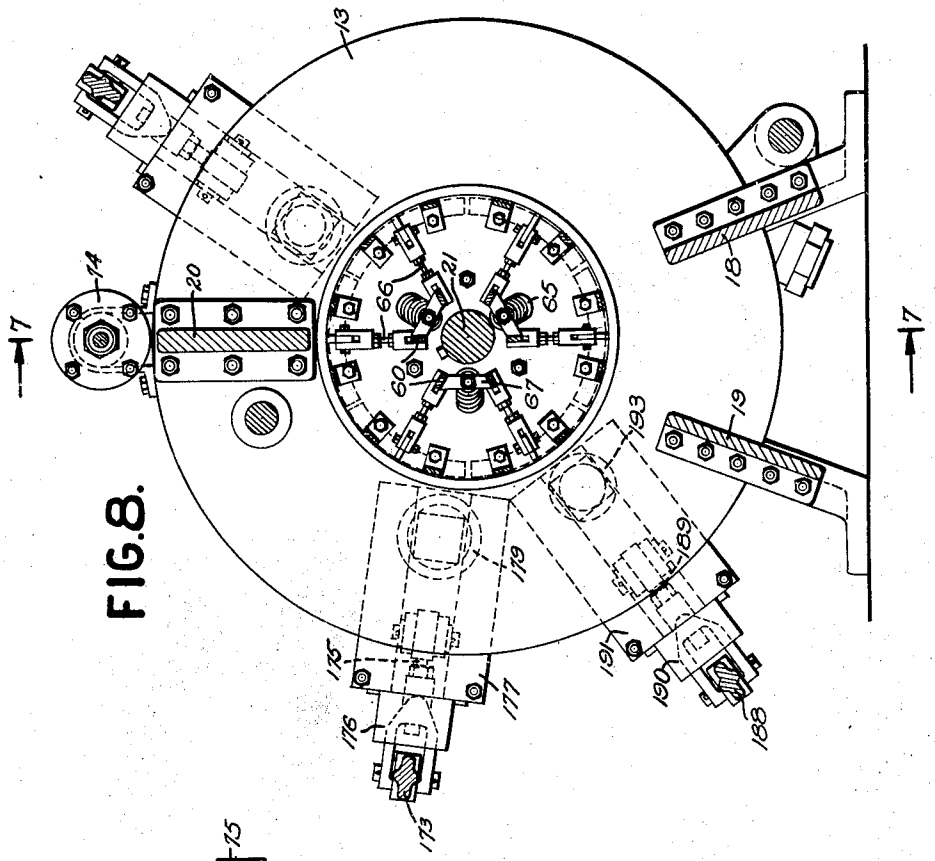

FIG. 8.

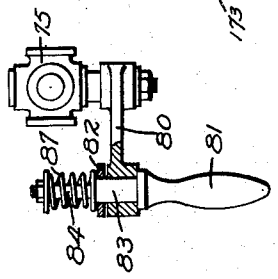

FIG. 15.

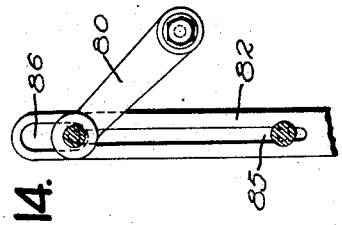

FIG. 14.

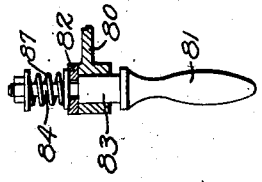

FIG. 16.

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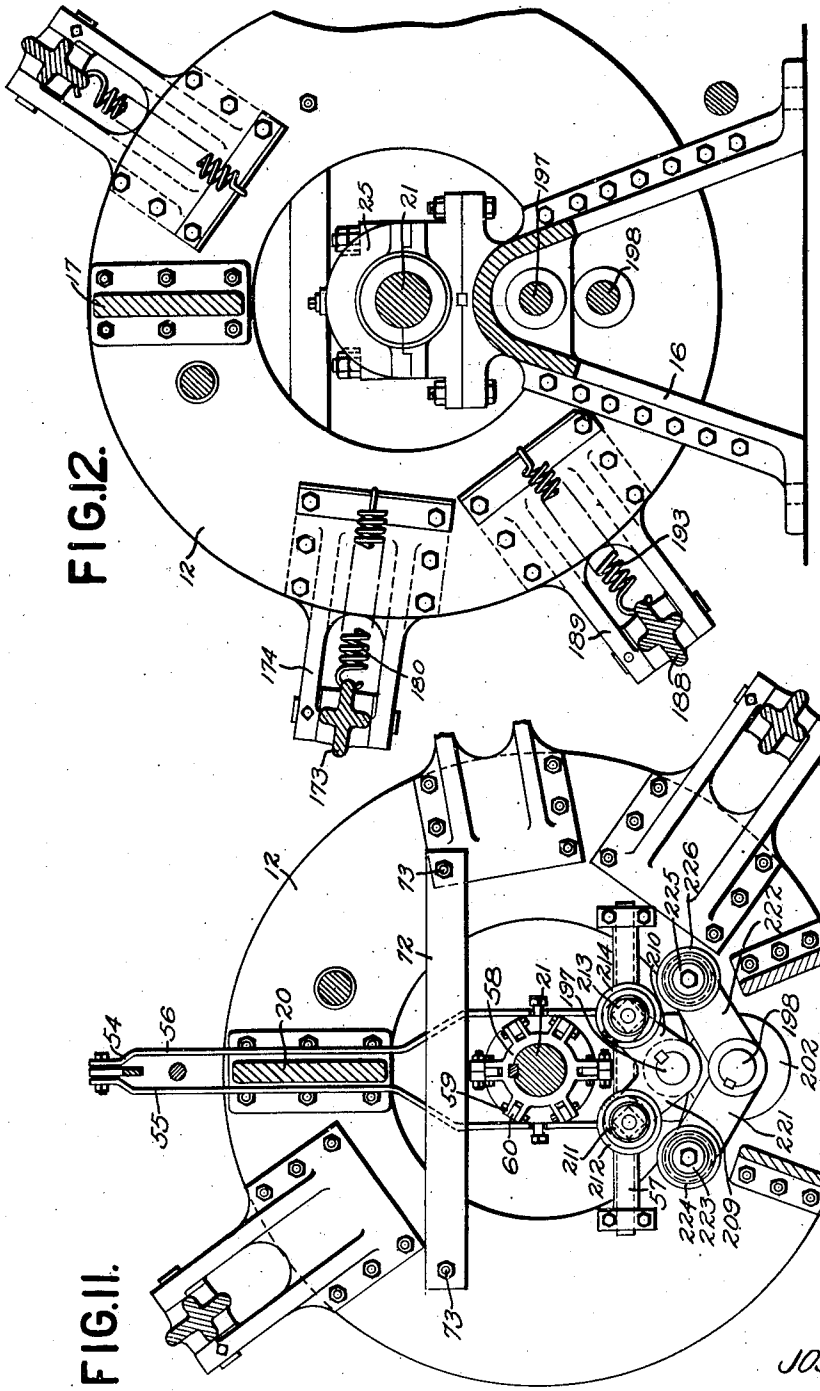

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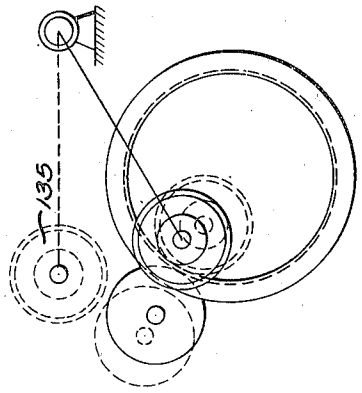
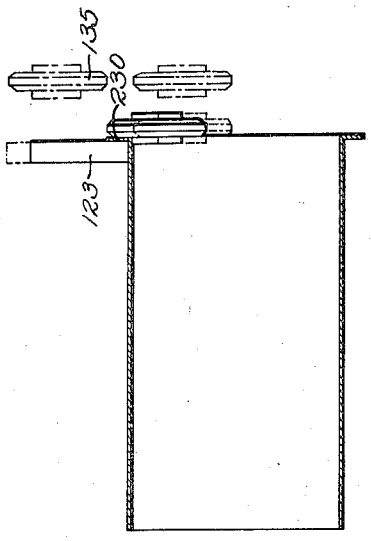


FIG. 20.



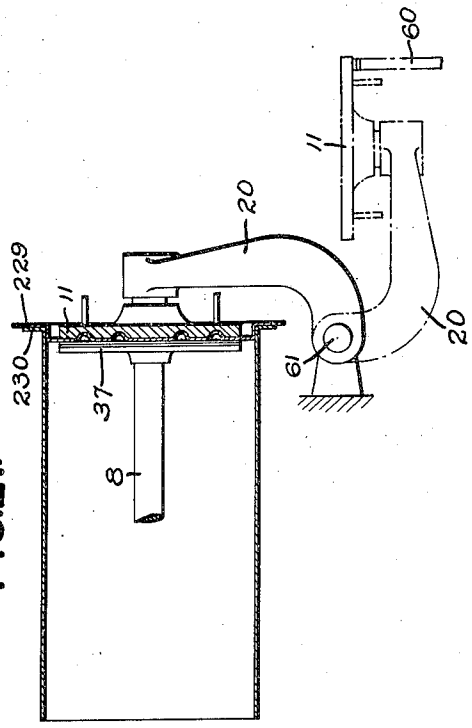


FIG. 21.

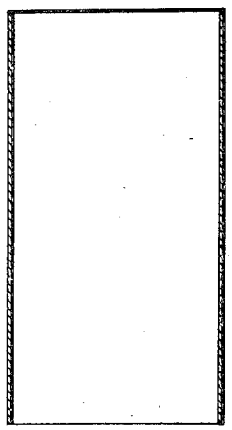


FIG. 17.

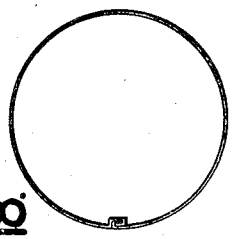


FIG. 18.

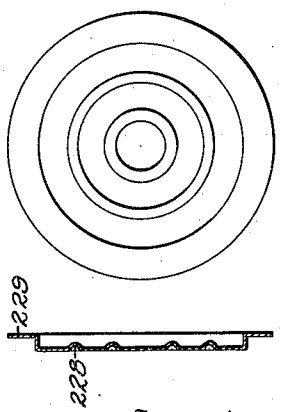


FIG. 19.

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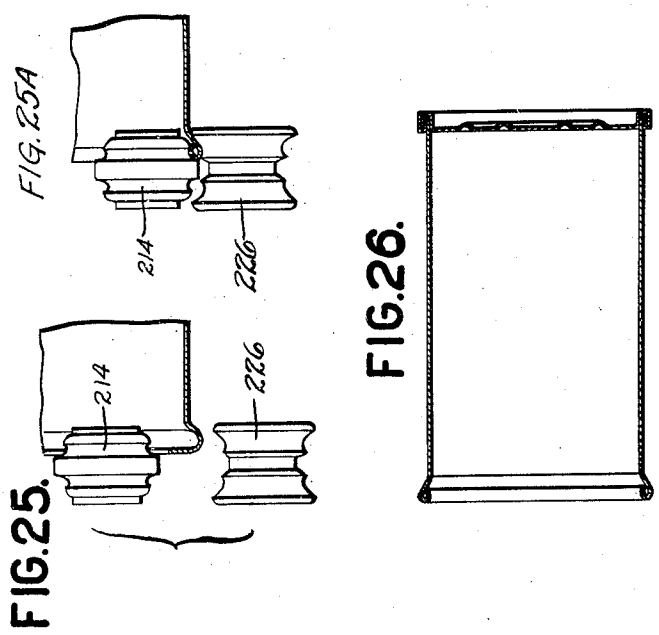

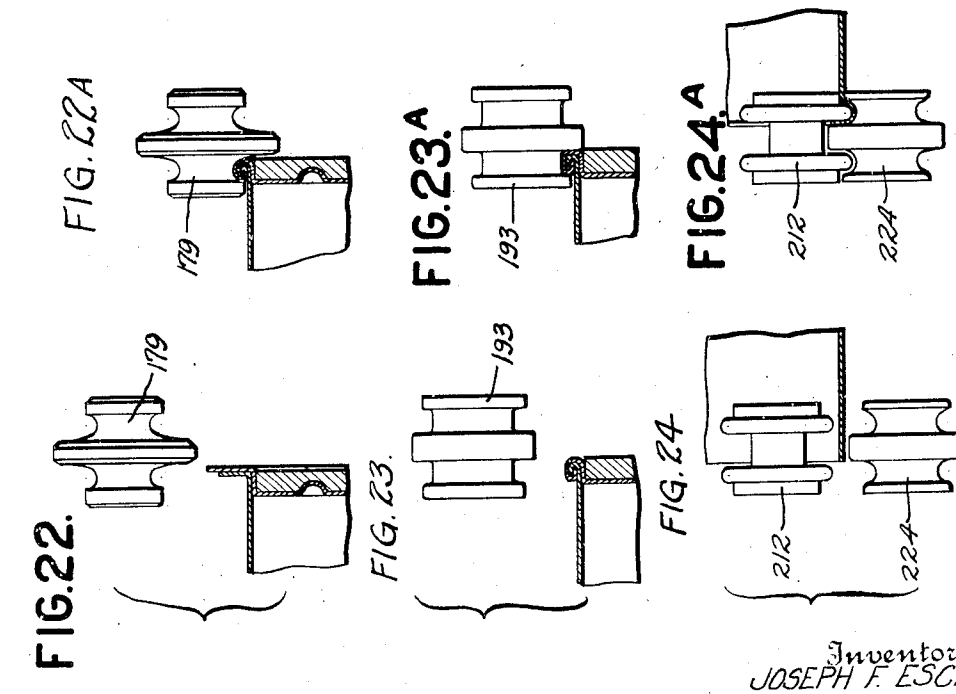

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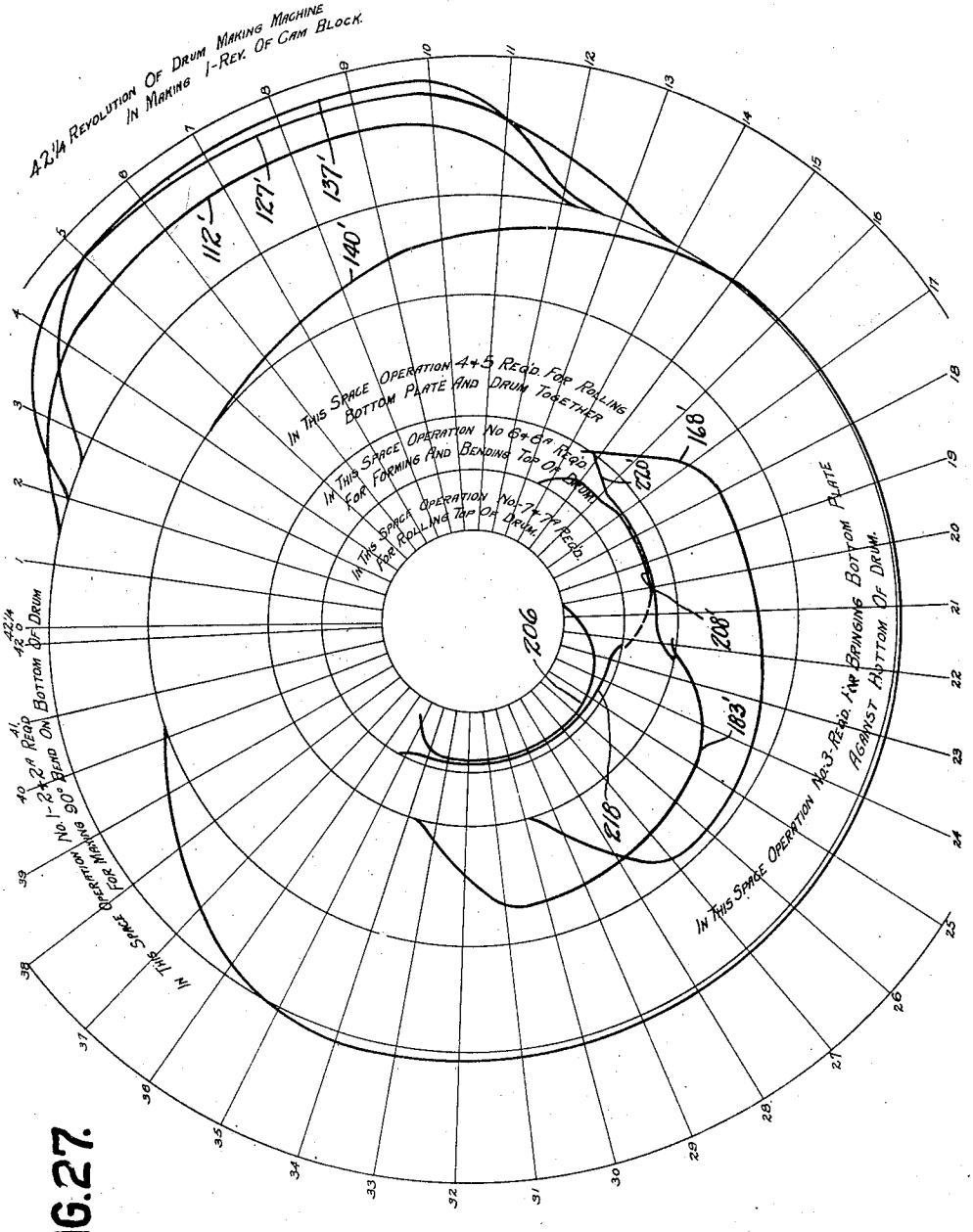

FIG.27.

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Patented May 12, 1936 2,040,785

UNITED STATES PATENT OFFICE

2,040,785

DRUM MAKING MACHINE

Joseph F. Esch, Port Neches, Tex., assignor to The Texas Company, New York, N. Y., a corporation of Delaware

Application March 18, 1933, Serial No. 661,552

18 Claims. (Cl. 113—23)

This invention relates to drum making machines and especially to machines of this type in which automatic operation takes the place of the manual operation required in the present machines.

In various industries there is a demand for drums having metal bodies and bottoms and capable of being closed for shipment by the simple expediency of inserting a more or less temporary closure in the open end of each drum. In the petroleum industry, for example, drums of this type are used for the shipment of asphalt and they are sealed after filling by inserting temporary wooden heads in the open ends of the drums. Obviously, the temporary heads must be held securely in position during shipment and at the same time be easily removed when it is desired to remove the contents of the drums. Heretofore the machines for making such drums have necessitated many manual operations thereby resulting in a costly product.

Accordingly, an object of the present invention is to provide a drum making machine of improved design and one which, to a large extent, operates automatically thereby providing an economical machine for making such drums.

Another object of the invention is to automatically roll a cylindrical body and bottom plate together to form an open top drum and at the same time form the top end of the drum in such a manner that after filling, the drum can be closed by applying a temporary or removable cover.

The present invention contemplates the use of preformed bottoms and preformed body portions.

In accordance with the present invention these and other objects are attained by a machine equipped with a drum holder which is adapted and arranged to engage the preformed body portion to hold the latter in position during the application of the bottom plate and while the top end is being bent to accommodate the temporary cover. A swing carriage on which the preformed bottom plate is placed by hand, or otherwise, is adapted and arranged to be swung into position adjacent the bottom end of the drum. A plurality of bending and forming rollers are provided for joining the bottom plate to the bottom end of the drum and for bending the top end of the drum to permit a temporary cover to be held thereon. The operations of the swing carriage and the bending and forming rollers are timed and synchronized by the use of a series of coordinated cams which are assembled on a cam block and one figure of the accompanying drawings, presently to be described, is devoted to a polar coordinate diagram which illustrates the succession, duration, stroke and character of every operation of the machine in turning out one finished drum.

In the drawings which form a part of this application there is illustrated a preferred embodiment of the invention, and

Fig. 1 is a view in side elevation of the machine.

Fig. 2 is a view in side elevation of the opposite side of the machine from Fig. 1.

Figs. 3, 4, 5, 6, 8, 9, 10, 11 and 12 are views in vertical section taken on the lines 3—3, 4—4, 5—5, 6—6, 3—8, 9—9, 10—10, 11—11 and 12—12, respectively of Fig. 1.

Fig. 7 is a view of a vertical section taken on line 7—7 of Fig. 8.

Fig. 13 is a view of a horizontal section taken on the line 13—13 of Fig. 1.

Figs. 14, 15 and 16 are enlarged detail views of regulating mechanism.

Fig. 17 is a longitudinal sectional view of a preformed cylinder.

Fig. 18 is a transverse sectional view of a preformed cylinder.

Fig. 19 is a front and sectional view of a preformed bottom.

Fig. 20 is a schematic view showing the position of the rollers during the flange forming operation.

Fig. 21 is a schematic view to illustrate the travel of the swing carriage when placing a preformed bottom adjacent the flange on the bottom of the drum.

Fig. 22 is a view showing the joint between the preformed bottom and flange on the cylindrical body and the roller for rolling this joint.

Fig. 22A is a view showing the joint illustrated in Fig. 22 after being rolled.

Fig. 23 is a view showing the rolled joint between the preformed bottom and the flange and the roller for flattening this joint.

Fig. 23A is a view of the flattened joint after rolling.

Fig. 24 is a view showing the top of the drum and the rolls for bending the top.

Fig. 24A is a view of the bent top.

Fig. 25 is a view showing the bent top of the drum, and the rolls for rolling the bent top.

Fig. 25A is a view of the bent top after rolling.

Fig. 26 is a view of the finished drum.

Fig. 27 is the polar coordinate diagram mentioned heretofore.

As shown in Figs. 1 and 2, the frame of the

machine comprises an end plate 10 and three supporting rings 11, 12 and 13. The end plate 10 and the adjacent ring 11 are braced in spaced relation by the cross beams 14 and 15, the outer ends of which are flared to form supports for the end plate 10. The central rings 11 and 12 are secured to opposite ends of a central support 16 and are braced in spaced relation at the top by a cross beam 17. The rings 12 and 13 are braced in spaced relation by the cross beams 18, 19 and 20. The outer end of the lower cross beams 18 and 19 flare outwardly to form supports for the ring 13.

A main shaft 21 for driving the machine extends through a suitable opening in the top of the end plate 10 and through the centers of the rings 11, 12 and 13. One end of the shaft 21 is journaled in a bearing 22 which is supported by an end stanchion 23 and the central portion of the shaft is journaled in the bearings 24 and 25 which are carried by the central support 16.

A clutch 26 for driving the shaft 21 is mounted thereon intermediate the end bearing 22 and the end plate 10. The clutch 26 comprises a driving member 27 and a driven member 28. The driven member 28 is adapted to be forced into frictional engagement with the driving member 27 by a lever 29, the upper end of which is pivotally connected to a master lever 30. The lower end of the lever 29 is pivotally connected to a bracket 31 which is secured to the end stanchion 23. The central portion of the lever 29 is pivotally connected to the driven member 28 of the clutch. When the master lever 30 moves to the right, as viewed in Fig. 1, the driven member 28 is forced into frictional engagement with the driving member 27. The driving member 27 may be rotated by any suitable source of power such as an electric motor (not shown) which may be geared directly to the driving member or coupled thereto by a belt.

A band brake 32 is mounted on the end of the shaft 21 and acts to stop the rotation of the shaft when the clutch 26 is disengaged. The band brake is operated by the master lever 30 through an L-shaped lever 33. The toe of the lever 33 is secured to the band of the brake and the heel is pivotally connected to a bracket 34 which is carried by the end bearing 22. The upper end of the lever 33 is pivotally connected to one end of a rod 35. The rod 35 has a reduced portion which is adapted to slide in a hole in the upper end of a bracket 36. The bracket 36 is adjustably connected to the master lever 30 by a set screw 37. A compression spring 38, positioned on the reduced portion of the rod 35 intermediate the collars 39 and 40, forces the upper end of lever 33 outwardly, thereby tightening the band on the brake when the clutch is disengaged. When the master lever 30 is moved to the right, as viewed in Fig. 1, the spring is released thereby loosening the band on the brake. A nut 41 which is threaded on the end of the reduced portion of rod 35 prevents the reduced portion from being pulled through the hole in bracket 36 when the brake is released.

A drum holder 43 for holding a preformed cylindrical body 42 of a drum is mounted on the forward end of the main drive shaft 21 and rotates in unison therewith. As shown more clearly in Fig. 7, the loading or forward wall of the drum holder comprises two metal rings 44 and 45 which are keyed to the shaft 21 and held in spaced relation by a collar 46. The outer ring 44 is provided with a tapered flange 47 to facilitate loading the preformed cylindrical bodies on the drum holder. The rear wall of the drum holder comprises two rings 48 and 49 which are keyed to the shaft 21 and held in spaced relation by a collar 50. The inner walls 45 and 48 are braced in spaced relation by cross beams 51 which also serve as the outer frame of the drum holder. A plurality of expander segments 52 are positioned between the rings 44 and 45 of the front wall at their outer peripheries and similar expander segments 53 are positioned between the rings 48 and 49 of the rear wall. The segments 52 and 53 are adapted and arranged to automatically expand outwardly into frictional engagement with the inner surface of the cylindrical body 42 when the machine starts and to automatically withdraw from the inner surface of the cylindrical body when the machine stops. The expansion and contraction of the segments 52 and 53 is accomplished by a lever 54, the upper end of which is pivotally connected to the master lever 30. As shown more clearly in Fig. 11, the lever 54 comprises two offset bars 55 and 56. The lower end of the bars 55 and 56 are pivotally connected to a bracket 57 which is carried by the ring 12. The central portion of the bars are pivotally connected to opposite sides of a collar 58 which is keyed to the shaft 21 and adapted and arranged to slide thereon. The collar 58 is provided with a plurality of radial projections 59 having slots therein within which the ends of levers 60 are connected. As shown in Fig. 7, the levers 60 extend outwardly along the shaft through the walls of the holder in sliding contact with spacer collars 46 and 50. The expander segments 52 are pivotally connected to the levers 60 by bars 61 which extend through radial slots in the ring 45, and angularly disposed adjustable links 62. In like manner the expander segments 53 are pivotally connected to the levers 60 by bars 63 which extend through radial slots in the ring 49 and angularly disposed adjustable links 64. Tension springs 65 are positioned within the drum holder to facilitate the expansion of the expander segments when the machine is started. The springs are connected at one end to bolts 66 which are secured to the front wall of the drum holder and at the other end to bars 67 which are connected to adjacent levers 60 (Fig. 8). When the lever 54 is in the position shown in Figs. 1 and 2, the expander segments are collapsed. When the lever 54 is moved by the master lever 30 to the left, as viewed in Fig. 2, the levers 60 are forced outwardly. As the levers 60 move outwardly they release the tension on springs 65 and tend to straighten the angularly disposed links 62 and 64 and as a result the expander segments are forced outwardly into firm frictional engagement with the inner surface of the cylinder 42. The intensity of the frictional engagement between the expander segments and the cylinder may be regulated by regulating the stroke of levers 60, by regulating the lengths of the links 62 and 64 or by regulating both the stroke of the levers and the lengths of the links.

The front part of the drum holder 43 is provided with a clutch 66' against which the preformed drum bottoms are placed. The clutch 66' acts to prevent deformation of the drum bottoms during subsequent crimping and rolling operations. The clutch 66' is resiliently secured to the front wall of the drum holder by the bolts 67', the heads of which are disposed in the holes 68 in the front face of the clutch. Compression springs 69 are positioned on the bolts 67 inter-

mediate the rear face of the clutch and the face of the front wall. The face of the clutch is desirably covered with a layer of rubber 70 or other suitable material capable of developing high friction.

A bracket 71, the shelf of which is tapered downwardly, is secured to ring 13 beneath the front end of the drum holder to facilitate placing the drum cylinders 42 on the holder.

A bar 72, which serves as a stop for the drum cylinders 42, is secured to plate 12 by bolts 73. The position of the bar may be adjusted on the bolts to permit cylinders of different lengths to be placed in position on the drum holder.

As shown more clearly in Figs. 1, 2 and 4, an air cylinder 74, which operates the master lever 30 to start and stop the machine, is mounted on the ring 13. The air cylinder is operated by a four-way air cock 75 which is also mounted on the ring 13. A pipe 76 leads from one side of the air cock to the rear of the cylinder and a similar pipe 77 leads to the front of the cylinder, as viewed in Fig. 2. Air under pressure is supplied to the remaining opposite side, of the air cock 75 by suitable pipes (not shown). As shown more clearly in Fig. 2, the piston rod 78 of the air cylinder is pivotally connected to the master lever 30 which operates the band brake 32, the clutch 26 and the expander segments 52 and 53 of the drum holder 43. The piston rod 78 is slidably journaled in a bracket 79 which is secured to the cross beam 20. When air under pressure is admitted to the left of the cylinder, as viewed in Fig. 2, the master lever 30 is in the position shown and the band brake 32 is operated, the clutch 26 is disengaged and the expanded segments 52 and 53 are collapsed. When air under pressure is admitted to the right of the cylinder, as viewed in Fig. 2, the master lever 30 moves to the left thereby releasing the band brake 32, engaging the clutch 26 and expanding the expander segments 52 and 53.

As shown more clearly in Figs. 4, 14, 15 and 16, the four-way air cock 75 is operated by a lever 80, a handle 81 and a control lever 82. The handle 81 is provided with a hub portion 83 and a reduced stud portion 84. The upper end of the control lever is provided with a relatively narrow slot 85 and a relatively wide slot 86 which opens from the narrow slot. The wide slot 86 permits the hub portion 83 of the handle to slide therein while the narrow slot 85 permits only the reduced stud portion 84 of the handle to slide therein. A compression spring 87 positioned on the reduced stud portion 84 acts to snap the hub portion 83 into the wide slot 86 when the handle is moved upwardly. To start the machine the handle 81 is pulled outwardly until the hub portion 83 is disengaged from the wide slot 86. The reduced stud portion 84 carrying the lever 80 is then pushed downwardly through the narrow slot 85 by handle 81 thereby forcing air under pressure from the air cock 75 to the rear of the air cylinder 74 to operate the master lever 30. The lower end of the lever 82 is connected to a shaft 149 to automatically stop the machine after a complete cycle of operation. The automatic stopping of the machine will be described in detail later.

As shown in Figs. 1 and 2, a cam block 90 carrying a gear 91 and cams 92–100, inclusive is loosely mounted on the shaft 21 intermediate the end plate 10 and the ring 11. The cam block 90 is rotated at a predetermined rate of speed by gears 106 and 107, shaft 108 and gears 109 and 91. As shown by the polar chart, the shaft 21 makes forty-two and one-quarter revolutions while the cam block 90 makes one revolution. It is to be understood, however, that satisfactory results may be obtained by rotating the shaft at a greater or lesser rate of speed with respect to the cam block. The shaft 108 carrying the gears 107 and 109 is journaled at one end in a bearing 110 which is supported by the end plate 10, and at the other end in a bearing 111 which is carried by the ring 11.

The cams on the cam block engage suitable cam followers at the rear end of the machine, which through a system of levers operate a swing carriage and a plurality of forming rollers at the front end of the machine in a predetermined manner.

As shown in Figs. 1, 3 and 4, the cam assembly 92 as it rotates, engages the cam follower or guide roller 112. The roller 112 is rotatably mounted on one end of a shaft 113, the other end of which is secured to the lower end of a slide plate 114. The plate 114 is adapted to slide in a suitable slide box 115 which is carried by ring 11. The central portion of the slide plate 114 is pivotally connected to the lower end of a rod 116. The upper end of rod 116 is pivotally connected to the rear end of a lever arm 117. The central portion of lever arm 117 is balanced on a rocker arm support 118 which is carried by ring 12. The front end of the lever arm 117 (Figs. 1 and 4) is pivotally connected to the upper end of a rod 119. The lower end of the rod 119 is pivotally connected to the central portion of a slide plate 120. The plate 120 is adapted to slide in a slide box 121 which is carried by the ring 13. The lower end of the plate 120 carries a shaft 122 on which a forming roller 123 is rotatably mounted. Tension springs 124 and 125 act to maintain the guide roller 112 in contact with the cam assembly 92 as it rotates. By this arrangement any movement imparted to the guide roller 112 by the cam assembly 92, at the rear of the machine, is transmitted in the opposite direction over lever 117 to the forming roller 123 at the front of the machine.

As shown more clearly in Figs. 1, 2, 4, 5 and 6, the cam assembly 93 as it rotates engages a guide roller 127. The guide roller 127 is mounted on a shaft 128 which is carried at one end of a swing lever 129. The other end of the swing lever 129 is keyed to the rear end of a shaft 130 which extends along the machine above the main shaft 21. One end of the shaft 130 is journaled in a bearing 131 carried by the ring 11 and the other end of the shaft is journaled in the bearing 132 carried by the ring 13. A similar swing lever 133 (Fig. 4) is keyed to shaft 130 at the front end of the machine. The swing lever 133 carries a shaft 134 on which a forming roller 135 is rotatably mounted. The ends of swing levers 129 and 133 are weighted by weights 136, 136 to maintain the guide roller 127 in contact with cam 93. By this arrangement the radial movement imparted to guide roller 127 by the cam assembly 93 in the rear of the machine is transmitted by shaft 130 to the forming roller 135 in the front of the machine.

Also as the cam assembly 93 rotates the cam assembly 94 which is secured thereto (Fig. 5) engages the guide roller 137. The guide roller 137 is rotatably secured to the central portion of a swing lever 138. The lower end of the lever 138 is pivotally connected to the fixed cross

beam 15 and the upper end of the lever is pivotally connected to the outer end of a rod 139. The inner end of the rod 139 is connected to the rear end of the shaft 130. When the cam assembly 94 engages the guide roller 137, the shaft 130, carrying the forming roller 135 at the front end thereof, is moved axially inwardly. As soon as the guide roller 137 becomes disengaged from the cam assembly 94, it is actuated by the cam assembly 95 (Fig. 6). The cam assembly 95 forces the shaft 130 carrying the forming roller 135 axially outwardly.

As shown in Figs. 1, 4, 9 and 13, a guide roller 140 is actuated by the cam assembly 96 at the rear of the machine. The roller 140 is rotatably mounted on a shaft 141 which is carried by a swing lever 142. The swing lever 142 is pivotally secured by a pin 143 to the end plate 10. An adjustable lever 144 connects the swing lever 142 to a shaft 145 journaled in bearings 146 and 147 of a U-shaped lever 148, which is keyed to shaft 149. The shaft 149 extends along the lower part of the machine and is journaled at one end in a bearing 150 carried by the end plate 10 and at the other end in a bearing 151 carried by the ring 13 at the forward end of the machine as viewed in Fig. 1. A spiral gear 152 is keyed to the forward end of the shaft 149 and meshes with a spiral gear 153 which is keyed to the lower end of a shaft 154. The shaft 154 is positioned in an angle of approximately 25° to the vertical center line in the front of the machine (Fig. 4), and is journaled in the bearings 155 and 156, which are secured to the ring 13. A swing carriage comprising a U-shaped lever 157, which carries a hub 158, is secured to the shaft 154. One end of a bearing pin 159 is secured in the hub 158. A plate 160, having bearing 161, is rotatably mounted on the pin 159. A magneto set 162 is mounted on the back of the plate 160 to render the plate magnetic.

As the guide roller 140 moves to the right as viewed in Fig. 5, under the influence of the cam assembly 96, the shaft 149 is rotated clockwise by levers 142, 144 and 148. As shaft 149 rotates in this direction it rotates the gear 152 which in turn rotates the gear 153 and shaft 154 thereby swinging the magneto plate 160 of the swing carriage against clutch 66' on the face of the drum holder. As the guide roller 140 moves to the left under the influence of the cam assembly 96, the shaft 149 is rotated anti-clockwise and the swing carriage is restored to its normal position.

The U-shaped lever 157 is adjustably mounted on shaft 154 by set screws 163 and 164 and since shaft 154 is positioned in an angle to the vertical center line, the position of the swing carriage may be adjusted radially so that the plate 160 is swung against the central portion of the clutch 66' on the face of the drum holder.

The bearing pin 159 is adjustably secured in the hub 158 by set screws 165 and 166 to permit axial adjustment of the plate 160.

The bearings 155 and 156 in which shaft 154 rotates and the bearing 161 which rotates on bearing pin 159 are desirably provided with ball bearings.

A stop 167 (Fig. 13) is secured to the ring 13 against which the plate 160 rests when in its normal position.

As shown in Figs. 1, 2, 3, and 4, a guide roller 168 is actuated by the cam assembly 97. The roller 168 is rotatably mounted on a shaft 169 which is secured to the inner end of a slide plate 170. The slide plate 170 is adapted to slide in a slide box 171 which is carried by the ring 11. The central portion of the slide plate 170 is pivotally connected to the inner end of an adjustable rod 172. The outer end of the adjustable rod 172 is pivotally connected to the rear end of a lever 173 as viewed in Fig. 1. The central portion of the lever 173 is balanced on a rocker arm support 174 which is carried by the ring 12. The front end of the lever 173 is pivotally connected to the outer end of an adjustable rod 175. The inner end of the adjustable rod 175 is secured to the central portion of a slide plate 176. The slide plate 176 is adapted to slide in a slide box 177, which is carried by the ring 13. The inner end of the slide plate 176 carries a shaft 178 on which a forming roller 179 is rotatably mounted. Tension springs 180 and 181 act to maintain the roller 168 in contact with the cam assembly 97. By this arrangement the radial motion imparted to roller 168 by the cam assembly 97, in the rear of the machine, is transmitted in the opposite direction by the lever 173 to the forming roller 179 in the front part of the machine.

As shown by Figs. 2 and 3, a guide roller 183 is actuated by the cam assembly 98. The roller 183 is rotatably mounted on one end of a shaft 184, the other end of which is secured to the inner end of a slide plate 185. The slide plate 185 is adapted to slide in a slide box 186, which is secured to the ring 11. The central portion of the slide plate 185 is pivotally secured to the inner end of an adjustable rod 187. The outer end of the rod 187 is pivotally connected to the right end of a lever 188 as viewed in Fig. 2. The central portion of the lever 188 is balanced on a rocker arm support 189 carried by the ring 12. The left end of the lever 188 is connected to the outer end of an adjustable rod 189. The inner end of the adjustable rod 189 is pivotally secured to the central portion of a slide plate 190. The slide plate 190 is adapted to slide in a slide box 191 which is secured to the ring 13. The inner end of the slide plate 190 carries a shaft 192 on which a forming roller 193 is rotatably mounted. Tension springs 194 and 195 act to maintain the guide roller 183 in contact with the cam assembly 98. By this arrangement the radial movement imparted to the guide roller 183 by the cam assembly 97 in the rear of the machine is transmitted in the opposite direction over lever 188 to the forming roller 193 in the front part of the machine.

As shown in Figs. 1, 2, 3, 10, 11 and 12, two shafts 197 and 198 are positioned under the main shaft 21. Shaft 197 is journaled in bearings 199 and 200 which are carried by the center support 16. Shaft 198 is journaled in bearings 201 and 202 which are carried by rings 11 and 12, respectively. Angle levers 203 and 204 (Fig. 10) are keyed to the rear end of the shaft 197. The angle lever 203 carries a shaft 205 on which a guide roller 206 is rotatably mounted. The angle lever 204 carries a shaft 207 on which a guide roller 208 is rotatably mounted. Similar angle levers 209 and 210 (Fig. 11) are keyed to the forward end of the shaft 197. The angle lever 209 carries a shaft 211 on which a forming roller 212 is mounted and the angle lever 210 carries a shaft 213 on which a forming roller 214 is mounted. Similar angle levers 215 and 216 (Fig. 3) are keyed to the rear end of the shaft 198. The angle lever 215 carries a shaft 217 on which a guide roller 218 is rotatably

mounted and angle lever 216 carries a shaft 219 on which a guide roller 220 is rotatably mounted. Similar angle levers 221 and 222 (Fig. 11) are keyed to the forward end of the shaft 198. The angle lever 221 carries a shaft 223 on which a forming roller 224 is rotatably mounted and the angle lever 222 carries a shaft 225 on which a forming roller 226 is rotatably mounted.

As the cam assembly 98 rotates it moves the roller 208 and the angle lever 204 downwardly thereby rotating the shaft 197. As shaft 197 rotates, the forming roller 212 is moved downwardly by the lever 209 and the forming roller 214 is moved upwardly by the lever 210.

As the cam assembly 99 rotates it engages the guide roller 218 and moves the angle lever 215 downwardly thereby rotating the shaft 198 in a direction opposite to the direction in which shaft 197 is rotating. As the shaft 198 rotates it moves the lever 222 and the forming roller 226 downwardly and moves the lever 221 and the forming roller 224 upwardly.

As soon as the cam assembly 98 frees the guide roller 208 the cam assembly 100 engages the guide roller 206 and moves the lever 203 downwardly thereby rotating shaft 197 in the opposite direction. As the shaft 197 rotates in this direction it moves the lever 210 and the forming roller 214 downwardly and the lever 209 and the forming roller 212 upwardly.

After the cam assembly 99 frees the guide roller 218 it engages roller 220 and moves lever 216 upwardly thereby rotating shaft 198 in the opposite direction. As the shaft 198 moves in this direction it moves the lever 221 and the forming roller 224 downwardly.

The cam assembly 100 in its rotation also engages the lever 204 and moves shaft 197 back to its original position. The cam assembly 96 in its rotation also engages the lever 215 and moves the shaft 198 back to its original position.

At the beginning of a cycle of operation, the machine is in the position shown in Figs. 1 and 2, that is, the driving member 27 of the clutch is disengaged from the driven member 28, the band brake 32 is tightened on shaft 21 and the expander segments 52 and 53 of the drum holder are collapsed. A preformed cylinder 42 is then placed on the drum holder 43 against the back stop 72 and a preformed bottom plate is placed on the plate 160 of the swing carriage. As shown in Fig. 19, the preformed plate has a plurality of annular corrugations 228 and an offset flange 229. The machine is then started by manipulating the handle 81 thereby rotating the main shaft 21, the drum holder 43 and expanding the expander segments 52 and 53 outwardly into frictional engagement with the body portion 42. As the main shaft 21 rotates it rotates the cam block 90. The various automatic operations controlled by this cam block and their sequence and duration will be more clearly understood by reference to polar chart shown in Fig. 27. The various polar curves of this chart are drawn with reference to the zero or starting position to indicate the displacement of the several guide rollers, the curve number indicating the particular guide roller in each case.

As shown by curve 112' on this polar chart approximately one and one-half revolutions of the main shaft 21, the cam assembly 92 begins to force the guide roller 112 upwardly in the rear of the machine thereby forcing the forming roller 123 downwardly in the front of the machine. At approximately four and one-half revolutions the forming roller 123 is forced downwardly into contact with the outer surface of the cylinder 42 as shown in Fig. 20. This forming roller is maintained in contact with the outer surface of the cylinder until about the beginning of the tenth revolution of the shaft at which time the cam assembly 92 begins to lower the guide roller 112 in the rear of the machine thereby raising the forming roller out of contact with the outer surface of the cylinder. At approximately the beginning of the twelfth revolution the forming roller has been restored to its initial position.

As shown by curve 127' on this chart at approximately the beginning of the second revolution of the main shaft 21, the cam assembly 93 begins to force the guide roller 127 in the rear of the machine downwardly thereby lowering the forming roller 135 in the front of the machine, as shown in Fig. 20. At approximately the beginning of the fifth revolution of the main shaft, the forming roller 135, in the front of the machine, is lowered to its lowermost position, that is, it is below the inner surface of the cylinder. After approximately two and one-half revolutions of the main shaft 21, as shown by curve 137', the cam assembly 94 begins to force the guide roller 137 in the rear portion of the machine backwardly thereby forcing the forming roller 135 inwardly. After approximately six revolutions of the shaft, or shortly after the roller has been lowered to its lowermost position, the roller is forced inwardly below the outer edge of the cylinder. It is thus seen that as roller 135 moves radially it also moves axially and that it is lowered to its lowermost position shortly before it is moved to its innermost position thereby permitting it to clear the outer edge of the cylinder. As shown by curve 127', as soon as the roller 135 is moved into the outer end of the cylinder it is gradually forced upwardly, guide roller 112 in the meantime keeping forming roller 123 in contact with the cylinder and guide roller 135 keeping the forming roller 135 axially displaced inwardly. As forming roller 135 moves upwardly it bends the outer edge of the cylinder backwardly against forming roller 123 to form a flange 230. After approximately 10 revolutions of the shaft the flange is formed and guide roller 112 in the rear of the machine is lowered thereby raising the forming roller 123 to its initial position. At approximately the beginning of the tenth revolution the cam assembly 95 engages the guide roller 137 and the cam assembly 94 becomes disengaged therefrom. As the cam assembly 95 engages the guide roller 137 it forces shaft 130 and the forming roller 135 axially outwardly to restore the forming roller 135 to its initial position.

At approximately the beginning of the fifth revolution or during the formation of the flange, as shown by curve 140', the cam assembly 96 engages the guide roller 140 in the rear of the machine and gradually swings the plate 160 carrying the preformed drum bottom towards the clutch 66 at the front end of the drum holder 43. At approximately the beginning of the sixteenth revolution, or after the flange 230 has been formed and the forming rollers 123 and 135 have been restored to their initial position, the plate 160 places the preformed drum bottom against the face of the clutch 66 so that the flange portion 229 of the preformed bottom is adjacent the flange 230, as shown in Fig. 21. As the preformed bottom is placed against the face of the clutch, the layer of frictional material 70 on

the face of the clutch engages the preformed drum bottom and rotates it and the plate 160 in unison therewith. The compression springs 69 maintain the layer of frictional material 70 in engagement with the drum bottom.

As shown by curve 168', after approximately fourteen and one-half revolutions of the main shaft, or shortly before the preformed bottom is placed against the flange 230, the guide roller 168 is actuated by the cam assembly 98 and as a result the forming roller 179 is forced inwardly. At approximately the beginning of the eighteenth revolution, or shortly after the preformed bottom has been placed against the flange 230, the forming roller 179 has been lowered until it is in contact with the flange. From approximately the beginning of the nineteenth revolution to approximately the beginning of the twenty-eighth revolution the forming roller 179 is gradually forced downwardly to roll the flanges 229 and 230 together, as shown in Fig. 22. From the beginning of the twenty-eighth revolution to the beginning of the thirty-first revolution, that is, after the flanges 229 and 230 have been rolled together, the forming roller 179 is returned to its initial position.

As shown by curve 183', at the beginning of approximately the twenty-third revolution of the shaft, the cam assembly 99 engages guide roller 183 and forces the forming roller 193 at the front of the machine downwardly. At approximately the beginning of the twenty-fifth revolution the forming roller 193 is forced into contact with the joint formed by roller 179. From the beginning of the twenty-fifth to approximately the beginning of the thirty-second revolution the forming roller 193 is gradually forced downwardly to flatten the rolled joint formed by roller 179, as shown in Fig. 23. From approximately the beginning of the thirty-second revolution to approximately the beginning of the thirty-fifth revolution the guide roller 183 forces the flattening cam 193 back to its initial position.

During the rolling and flattening of the joint between the preformed bottom and the flange, the top of the drum is flanged to enable it to receive a temporary cover. This operation is carried out in two steps, the first step being performed by forming rollers 212 and 224, and the second step being carried out by forming rollers 214 and 226. The forming rollers 212 and 224 are operated by guide rollers 208 and 220, respectively, which are positioned at the rear of the machine. The forming rollers 214 and 226 are operated by guide rollers 206 and 218, respectively, which are also positioned at the rear end of the machine. To permit the drum to be easily and completely unloaded the flange on the top of the drum is desirably formed so that its diameter is slightly greater than the diameter of the drum and for this reason roller 212 is lowered shortly before collar 214 is raised. After approximately thirteen and one-half revolutions, as shown by curve 208', the cam assembly 98 in rotating anti-clockwise, as viewed in Fig. 10, moves the guide roller 208 downwardly thereby rotating shaft 197 in a clockwise direction, as viewed in Fig. 10, and anti-clockwise, as viewed in Fig. 11. As shaft 197 rotates anti-clockwise, as viewed in Fig. 11, the forming roller 212 is forced downwardly. At approximately the beginning of the sixteenth revolution the forming roller 212 is brought into contact with the lower inner surface of the drum and is maintained in this position until approximately the beginning of the seventeenth revolution. As shown by curve 220', at approximately the beginning of the sixteenth revolution, the cam assembly 99 in rotating anti-clockwise, as viewed in Fig. 3, engages the guide roller 218 and forces it downwardly thereby rotating shaft 198 anti-clockwise, as viewed in Fig. 3, and clockwise, as viewed in Fig. 11. As shaft 198 rotates clockwise, as viewed in Fig. 11, it forces the forming roller 224 upwardly. At approximately the beginning of the seventeenth revolution the forming roller 224 is forced into contact with the outer surface of the drum, at which time guide roller 208, under the influence of the cam assembly 98, acts to force the forming roller 212 further downwardly to bend the drum, as shown in Fig. 24. The forming rollers 212 and 224 are maintained in this position until the beginning of approximately the twenty-first revolution. Since the forming roller 214 is also operated by the shaft 197 which operates the forming roller 212 and the forming roller 226 is operated by the shaft 198 which operates the forming roller 224, the forming rollers 214 and 226 are spread apart when the forming rollers 212 and 224 are brought together thereby permitting the bent edge of the drum to pass between the forming rollers 214 and 226.

As soon as the cam assembly 98 frees roller 208, or shortly after the beginning of the twenty-first revolution, cam 100 moves roller 206 downwardly thereby turning the shaft 197 anti-clockwise, as viewed in Fig. 10, and clockwise, as viewed in Fig. 11. As shaft 197 rotates clockwise, as viewed in Fig. 11, it forces the forming roller 214 downwardly into contact with the bent edge of the drum. Shortly after the beginning of the twenty-third revolution, the cam assembly 99 frees roller 218 and moves roller 220 downwardly thereby rotating shaft 198 clockwise, as viewed in Fig. 3, and anti-clockwise, as viewed in Fig. 11. As shaft 198 rotates anti-clockwise, as viewed in Fig. 11, it forces the forming roller 226 upwardly into contact with the bent edge of the drum and holds it in place while the forming roller 214 moves still further downwardly to roll the bend on the top of the drum, as shown in Fig. 25.

At the end of approximately thirty-three and one-half revolutions, the cam assembly 98 engages the lever 203 on which roller 206 is mounted and forces the roller back to its initial position and the cam assembly 97 engages the lever 215 on which roller 218 is mounted and forces the roller back to its initial position.

After the end of approximately the thirty-fifth revolution, the cam assembly 96 raises the guide roller 140 and rotates shaft 149 anti-clockwise thereby restoring the plate 160 to its initial position.

While shaft 149 is rotating to swing plate 160 carrying the preformed bottom against the end of the cylinder, lever 82 is pulled downwardly thereby permitting the hub portion 83 of the starting handle 81 to be pulled through the wide slot 86 by spring 87. When the direction of rotation of shaft 149 is reversed the lever 82 forces the handle 81 upwardly thereby reversing the flow of air in the air cylinder and stopping the machine.

While the present invention is described in connection with the formation of circular drums it is to be understood that it is equally applicable to the formation of drums having other shapes. It is also to be understood that various modifications may be made in the construction of the machine.

I claim:

1. In a drum making machine, the combination of a rotatable drum holder adapted to engage the body portion of a drum and to hold the drum in a horizontal position, a plurality of forming rollers for forming a flange on one end of said body portion, a carriage for swinging a preformed drum bottom into position against said flange, a plurality of forming rollers for uniting said preformed drum bottom and said flange, and a plurality of rollers for forming a temporary cover holding flange on the other end of said body portion.

2. In a drum making machine, the combination of a main shaft, an expandible drum holder mounted on said shaft, means for rotating said shaft and expanding said drum holder into engagement with the body portion of a drum, means for forming a flange on one end of said body portion, a swing carriage for advancing a preformed drum bottom adjacent said flange, a plurality of rollers for uniting said flange and said preformed bottom, and a plurality of rollers for forming a temporary cover holding flange on the other end of said body portion.

3. In a drum making machine, the combination of a main shaft, an expandible drum holder mounted on said shaft, means for rotating said shaft and expanding said drum holder into engagement with the body portion of a drum, a plurality of rollers for forming a flange on one end of said body portion, a swing carriage having a plate rotatably mounted thereon and adapted to carry a preformed drum bottom, means for advancing said plate and said preformed bottom adjacent said flange, a plurality of rollers for uniting said flange and said preformed bottom, and a plurality of rollers for forming a temporary cover holding flange on the other end of said body portion.

4. In a drum making machine, the combination of a main drive shaft, an expandible drum holder mounted on said shaft, a clutch mounted on a face of said drum holder, means for rotating said shaft and expanding said drum holder into engagement with the body portion of a drum, a plurality of forming rollers for forming a flange on one end of said body portion, a swing carriage having a plate rotatably secured thereto and adapted to carry a preformed drum bottom, means for advancing said plate carrying a preformed drum bottom against said clutch and said flange, a plurality of rollers for uniting said preformed drum bottom and said flange and a plurality of rollers for forming a temporary cover holding flange on the other end of said body portion.

5. In a drum making machine, the combination of a main driving shaft, an expandible drum holder mounted on said shaft, means for rotating said shaft and expanding said drum holder into engagement with the body portion of a drum, a plurality of rollers for forming a flange on one end of said body portion, a swing carriage having a plate rotatably mounted thereon, a magneto set mounted on said plate for rendering said plate magnetic to carry a preformed drum bottom, means for advancing said plate and a preformed drum bottom adjacent said flange, a plurality of rollers for uniting said flange and said preformed drum bottom, and a plurality of rollers for forming a temporary cover holding flange at the other end of said body portion.

6. In a drum making machine, the combination of a main shaft, an expandible drum holder mounted on said shaft, means for simultaneously rotating said shaft and expanding said drum holder into engagement with the body portion of a drum, a plurality of rollers for forming a flange on one end of said body portion, a swing carriage for advancing a preformed drum bottom adjacent said flange, a plurality of rollers for uniting said flange and said preformed bottom, a plurality of rollers for forming a temporary cover holding flange at the other end of body portion and means for automatically stopping said shaft and disengaging said drum holder from said body portion after a complete circle of operation.

7. In a drum making machine, the combination of a main shaft, an expandible drum holder mounted on said shaft, means for simultaneously rotating said shaft and expanding said drum holder into engagement with the body portion of a drum, a plurality of cam operated rollers for forming a flange on one end of said body portion, a cam operated swing carriage for advancing a preformed drum bottom adjacent said flange, a plurality of cam operated rollers for uniting said flange and said preformed bottom and a plurality of cam operated rollers for forming a temporary cover holding flange at the other end of said body portion.

8. In a drum making machine the combination of a main shaft, an expandible drum holder mounted on said shaft, means for simultaneously rotating said shaft and expanding said drum holder into engagement with the body portion of a drum, a plurality of cam operated rollers for forming a flange on one end of said body portion, a cam operated swing carriage for advancing a preformed drum bottom adjacent said flange, a plurality of cam operated rollers for uniting said flange and said preformed bottom, a plurality of rollers for forming a temporary cover holding flange at the other end of said body portion, and cam operated means for automatically stopping the machine.

9. In a drum making machine, the combination of a main shaft, an expandible drum holder mounted on said shaft, means for simultaneously rotating said shaft and expanding said shaft and expanding said drum holder into engagement with the body portion of a drum, a cam block, means for rotating said cam block with respect to said shaft, a plurality of rollers actuated by said cam block for forming a flange on one end of said body portion, a swing carriage actuated by said cam block for advancing a preformed drum bottom adjacent said flange, a plurality of rollers actuated by said cam block for uniting said flange and said preformed drum bottom, and a plurality of rollers actuated by said cam block for forming a temporary cover holding flange on the other end of said body portion.

10. In a drum making machine, the combination of a main drive shaft, an expandible drum holder mounted on said shaft, means for simultaneously rotating said shaft and expanding said drum holder into engagement with the body portion of a drum, a cam block, means for rotating said cam block with respect to said shaft, a plurality of rollers actuated by said cam block for forming a flange on one end of said body portion, a swing carriage actuated by said cam block for advancing a preformed drum bottom adjacent said flange, a plurality of rollers actuated by said cam block for uniting said flange to said preformed drum bottom, a plurality of rollers actuated by said cam block for forming a temporary cover holding flange on the other end of said

body portion, and means actuated by said cam block for automatically stopping said shaft and withdrawing said drum holder out of engagement with said body portion after a complete cycle of operation.

11. In a drum making machine, the combination of a main drive shaft, an expandible drum holder mounted on said shaft, means for simultaneously rotating said shaft and expanding said drum holder into engagement with the body portion of a drum, a cam block rotatably mounted on said shaft, and rotated thereby at a speed other than the speed at which said shaft is rotated, a plurality of rollers actuated by said cam block for forming a flange on one end of said body portion, a swing carriage actuated by said cam block for advancing a preformed drum bottom adjacent said flange, a plurality of rollers actuated by said cam block for uniting said flange and said preformed drum bottom, a plurality of rollers actuated by said cam block for forming a temporary cover holding flange at the other end of said body portion, and means actuated by said cam block for automatically stopping said shaft and disengaging said drum holder from said body portion after a complete cycle of operation.

12. In a drum making machine, the combination of a main drive shaft, an expandible drum holder mounted on said shaft, means for simultaneously rotating said shaft and expanding said drum holder into engagement with the body portion of a drum, a cam block rotatably mounted on said shaft and rotated thereby at a speed other than that at which said shaft is rotated, a plurality of cam assemblies actuated on said cam block, a plurality of rollers actuated by a plurality of said cam assemblies for forming a flange on one end of said body portion, a swing carriage actuated by one of said cam assemblies for advancing a preformed drum adjacent said flange, a plurality of rollers actuated by a plurality of said cam assemblies for uniting said flange to said preformed drum bottom, a plurality of rollers actuated by a plurality of said cam assemblies for forming a temporary cover holding flange on the other end of said body portion, and means actuated by the cam assembly which actuates said swing carriage for automatically stopping the shaft and disengaging said drum holder from said body portion after a complete cycle of operation.

13. In a drum making machine, the combination with a rotatable shaft, of an expandible holder mounted on said shaft and adapted to hold a preformed cylindrical drum body, said holder comprising a plurality of radially movable expander segments at each end of said holder, a plurality of longitudinally movable levers disposed parallel to said shaft, means pivotally connecting each of said levers with a pair of said expander segments, and means for moving said levers longitudinally to effect a radial movement of said expander segments and force the segments into engagement with the inner wall of a drum body on said holder.

14. In a drum making machine, the combination of a rotatable drum holder adapted to engage the body portion of a drum and to hold it in a horizontal position, a plurality of rollers for forming a flange on one end of said body portion, a carriage having a plate rotatably secured thereto for supporting and swinging a preformed drum bottom which has been manually positioned on said plate into a vertical position against said flange, means for actuating said swing carriage, and a plurality of rollers for uniting said preformed drum bottom and said flange.

15. In a drum making machine, the combination of a main shaft, an expandible drum holder mounted on said shaft, means for rotating said shaft and expanding said drum holder into engagement with the body portion of a drum, means for forming a flange on one end of said body portion, a swing carriage for advancing a preformed drum bottom adjacent said flange, and a plurality of rollers for uniting said flange and said preformed bottom.

16. In a drum making machine, the combination of a main shaft, an expandible drum holder mounted on said shaft, means for rotating said shaft and expanding said drum holder into engagement with the body portion of a drum, a plurality of rollers for forming a flange on one end of said body portion, a swing carriage having a plate mounted thereon and adapted to carry a preformed drum bottom, means for actuating said swing carriage to advance said plate and said preformed bottom adjacent to said flange, and a plurality of rollers for uniting said flange and said preformed bottom.

17. In a drum making machine, the combination of a main driving shaft, an expandible drum holder mounted on said shaft, means for rotating said shaft and expanding said drum holder into engagement with the body portion of a drum, a plurality of rollers for forming a flange on one end of said body portion, a swing carriage having a plate mounted thereon and adapted to carry a preformed drum bottom, induction means on said plate for rendering said plate magnetic to hold the preformed drum bottom thereon, means for advancing said plate and the preformed drum bottom adjacent said flange, and a plurality of rollers for uniting said flange and said preformed drum bottom.

18. In a drum making machine, the combination of a main shaft, an expandible drum holder mounted on said shaft, means for simultaneously rotating said shaft and expanding said drum holder into engagement with the body portion of a drum, a plurality of cam operated rollers for forming a flange on one end of said body portion, a cam operated swing carriage for advancing a preformed drum bottom adjacent said flange, and a plurality of cam operated rollers for uniting said flange and said preformed bottom.

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