July 20, 1954 E. F. LEE ET AL 2,684,103

METALWORKING APPARATUS

Filed Aug. 7, 1948 5 Sheets-Sheet 1

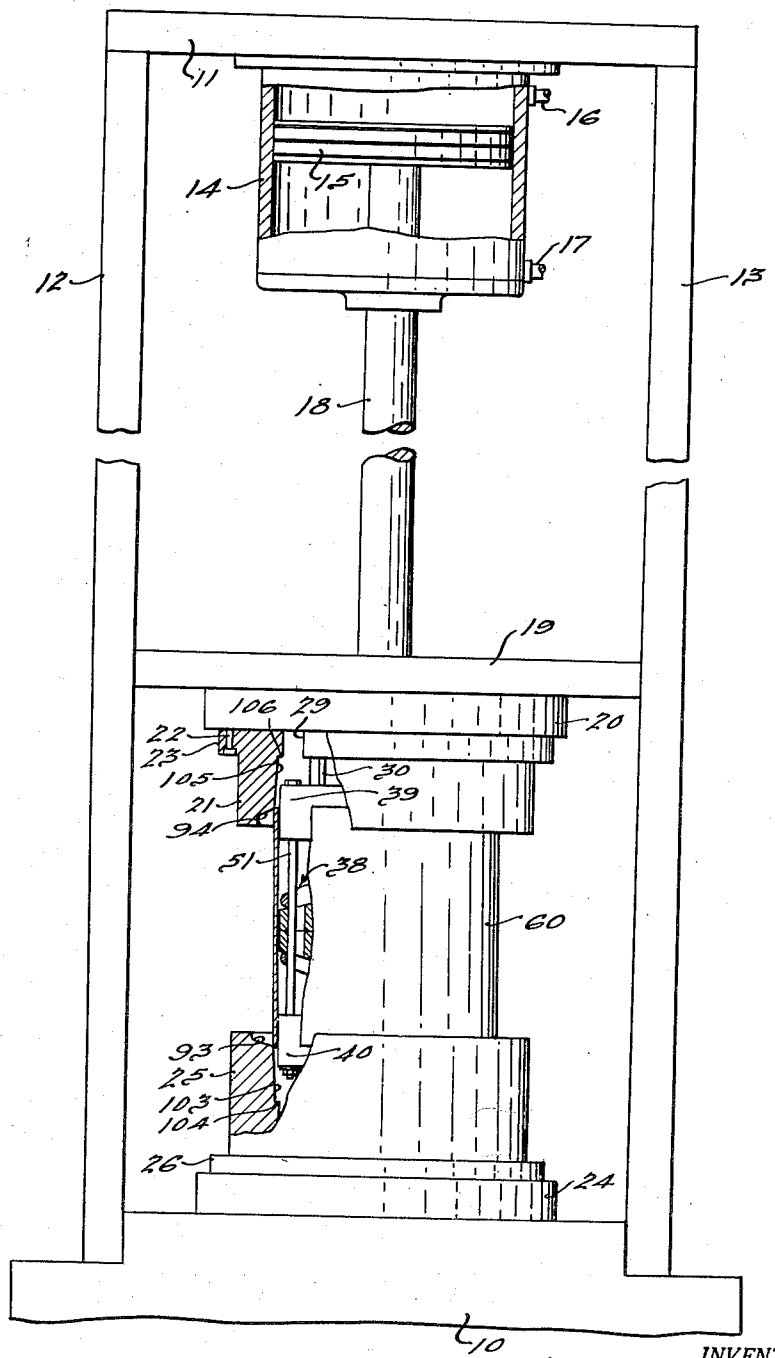


Fig. 1.

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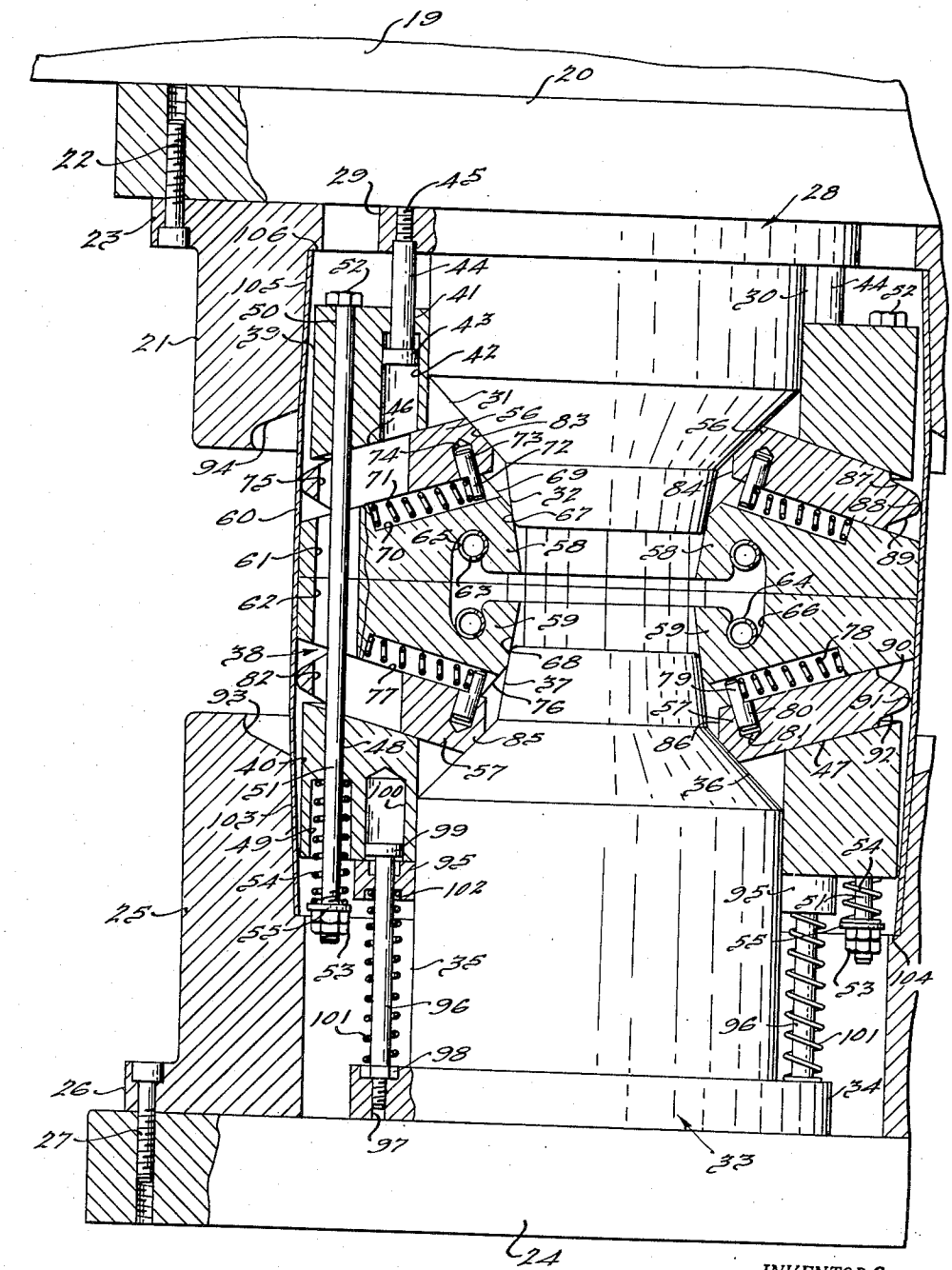


FIG. 2.

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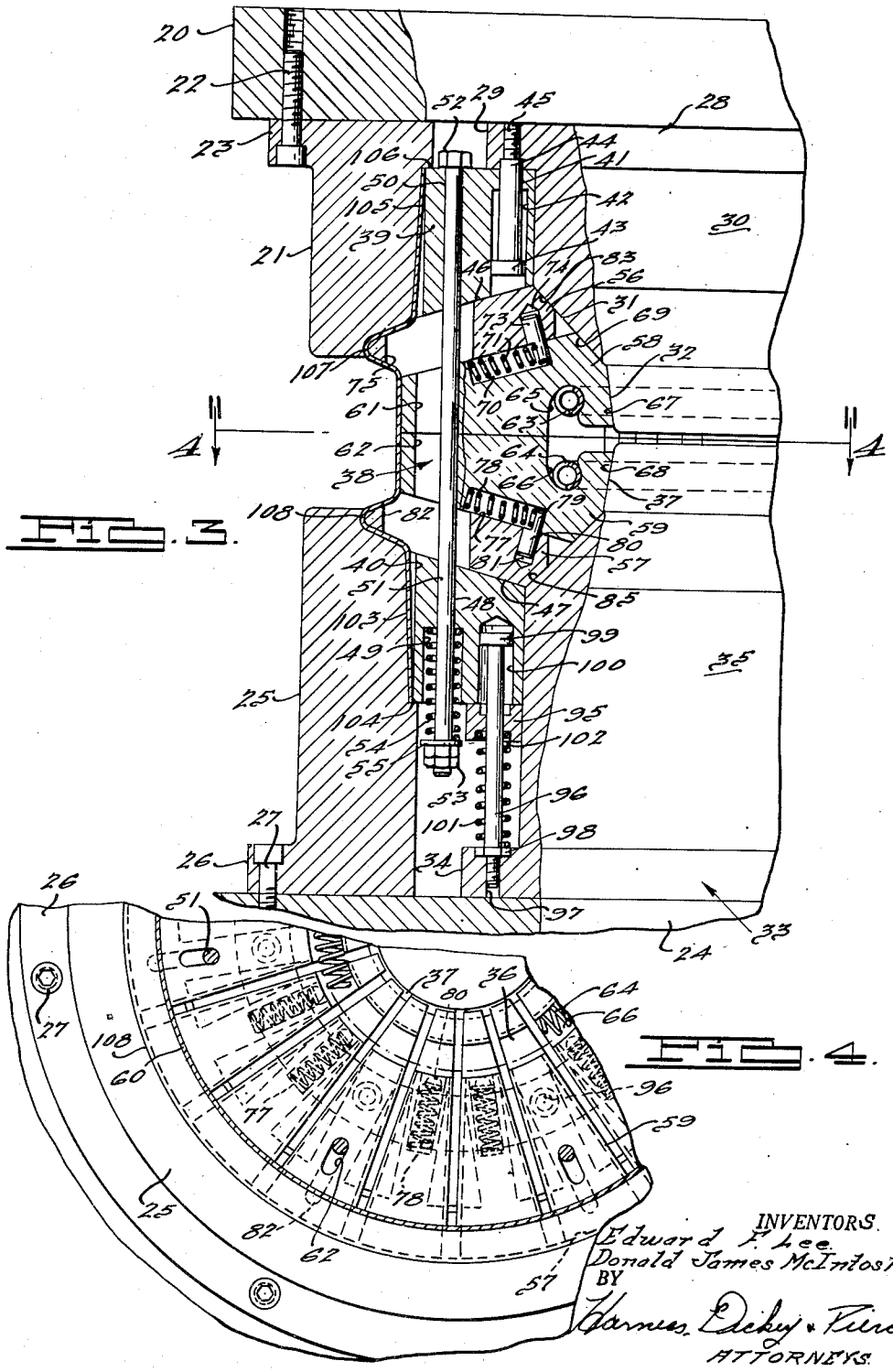


FIG. 3.

FIG. 4.

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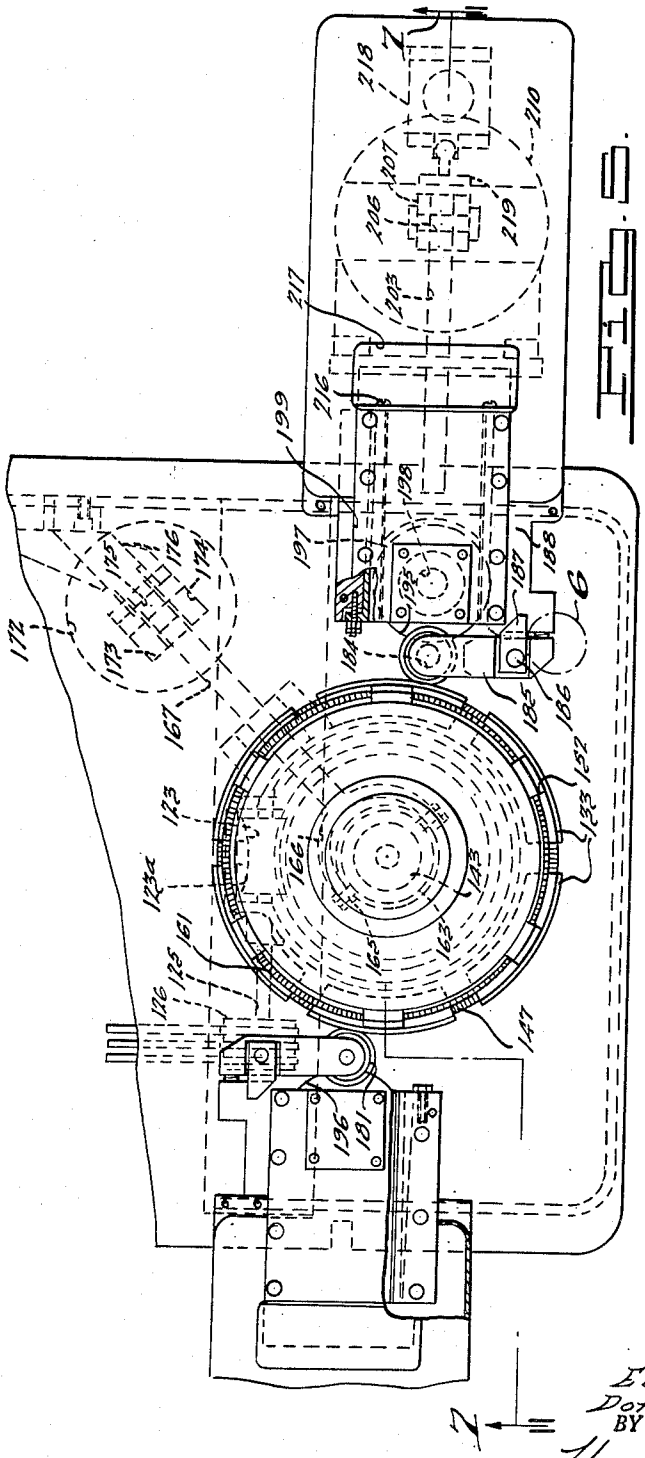


Fig. 5.

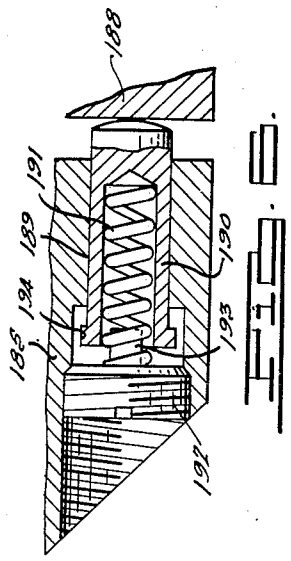


Fig. 6.

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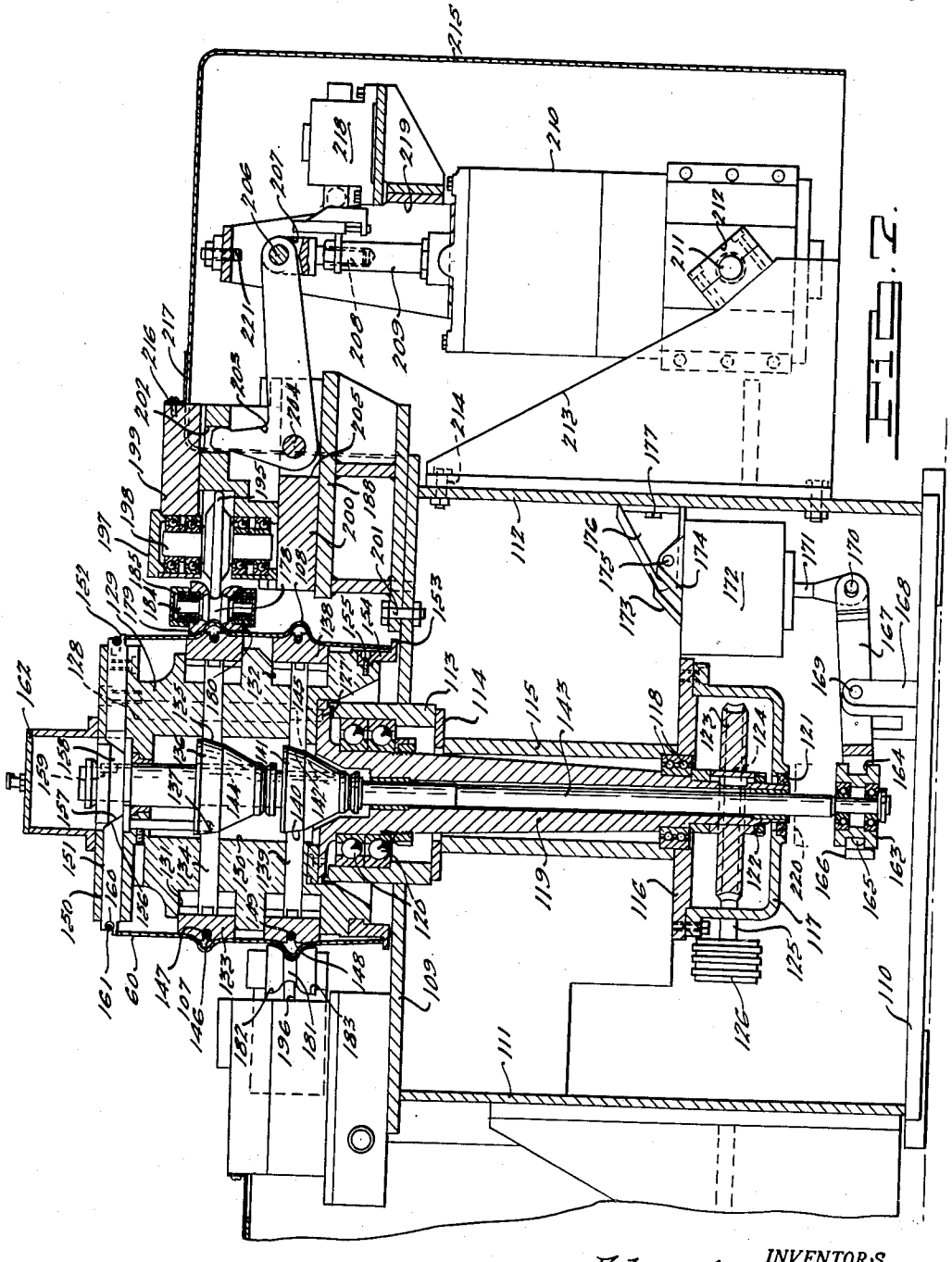


FIG. 2.

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2,684,103

UNITED STATES PATENT OFFICE

2,684,103

METALWORKING APPARATUS

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Application August 7, 1948, Serial No. 43,117

13 Claims. (Cl. 153—73)

1

The present invention relates to metalworking generally and more particularly to apparatus for forming circumferential ribs or runners on steel barrels or the like.

An object of the present invention is to provide a novel metalworking apparatus for forming circumferential ribs or runners on the sides of steel barrels or other similar cylindrical metal containers.

Another object of the invention is to provide a novel sheet metalworking apparatus for forming outwardly projecting ribs or runners on the sides of steel barrels or the like which are thicker at their outermost portions than the initial sheet.

A further object is to provide a novel metalworking machine for forming circumferential runners on a metal cylinder or the like, having a reciprocally movable ram thereon supporting a series of radially arranged expander shoes which are mounted for motion in an inclined plane and which cooperate with a cam surface to move outwardly to engage with the internal walls of the cylinder coincidentally with a telescoping force applied to the ends of the cylinder by the ram to form circumferentially channeled runners thereon without appreciable reduction of thickness which usually occurs in expanding operations.

Another object is to provide a novel metalworking machine for compressing the outer ends of circumferential ribs or runners formed on the side walls of a metal cylinder or the like, to provide a greater thickness of metal at the outer ends of the runners than at the side walls of the cylinder, the machine having a roller for engaging with the outer end of each rib or runner which is movable toward the cylinder to compress the metal it engages inwardly at the apices of the ribs or runners.

A still further object of the present invention is to provide an apparatus for constructing a stainless steel barrel or the like from a single sheet of metal which is formed into a cylinder having a uniform thickness throughout which consists in forming extending ribs on the sheet which are integral with the latter and of the same thickness and for thereafter compressing the outer ends of the ribs inwardly to provide a greater thickness of material thereat than at the side walls of the cylinder.

Other objects and advantages of the invention will become apparent from the following specification, the accompanying drawings and the appended claims.

In the drawings wherein like reference characters refer to like parts throughout the several views:

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Figure 1 is a side elevation view with parts in section of the novel press hereof for constructing ribs or runners on the side walls of a metal cylinder;

Fig. 2 is an enlarged side elevation view partially in section illustrating the expander shoes in a retracted position relative to the internal walls of a cylinder mounted on the press;

Fig. 3 is a view substantially similar to Fig. 2, illustrating the expander shoes in their outwardly extending position whereby runners have been formed in the walls of the cylinder;

Fig. 4 is a fragmentary view taken substantially along lines 4—4 of Fig. 3;

Fig. 5 is a top elevation view of the novel rolling machine hereof;

Fig. 6 is an enlarged view in section of that portion of the structure located within broken circular line 6 of Fig. 5; and

Fig. 7 is a view taken substantially along the line 7—7 of Fig. 5.

Referring now to the drawings for a more detailed description of the present invention and more particularly to Fig. 1 thereof, the novel runner forming machine or press hereof is shown as generally comprising a bed member 10 and a crown member 11, the two being spaced apart and secured together by virtue of side rails 12 and 13. Suitably supported by crown member 11, at a substantially central portion thereof is a power cylinder 14 having a piston 15 mounted for reciprocal movement therein, the interior of the cylinder communicating by way of conduits 16 and 17 with a more suitable source of fluid pressure (not shown) such as vacuum, hydraulic or pneumatic pressure, and, depending upon the power used, one of conduits 16, 17 will act as an inlet and the other as an outlet.

A piston rod 18 is connected at one of its ends with piston 15 for movement thereby and at its other end is connected to a ram 19 which is movable along side rails 12 and 13 by the piston. A punch holder 20 is supported at the underside and centrally of ram 19 and has a substantially annular hollow swaging ring 21 secured thereto by way of bolts 22, the latter passing through an outwardly extending flange 23 formed on the inner end of the ring. The upper end of bed member 10 has a die-shoe member 24 rigidly fastened thereto by suitable means (not shown) which supports thereon a second hollow swaging ring 25 similar to ring 21 having an outwardly extending flange 26 formed at its inner end, bolts 27 (Fig. 2) passing through flange 26 to secure ring 25 to die-shoe member 24.

As more clearly shown in Fig. 2, the underside of punch holder 20 carries thereon internally of

swaging ring 21, a punch member, generally designated with the reference character 28, having an outwardly extending flange portion 29 at its inner end, an intermediate reduced cylindrical portion 30 and two adjoining members, the inner one of which is provided with an inclined cam surface 31 and the outer one of which is provided with an inclined cam surface 32, the slope of the former cam surface being substantially greater than the slope of the latter cam surface. In a similar manner, the top of die-shoe member 24 carries a punch member thereon, generally designated with the reference character 33, internally of swaging ring 25, the punch member having an outwardly extending flange portion 34 at its inner end, an intermediate reduced cylindrical portion 35, and two adjoining members, the inner one of which is provided with an inclined cam surface 36 and the outer one of which is provided with an inclined cam surface 37, the slope of the former cam surface being substantially greater than the slope of the latter cam surface.

In addition to carrying swaging ring 21 and punch member 28, punch holder 20 also supports at its underside an expander shoe assembly, generally designated with the reference character 38, such assembly comprising (as better shown in Fig. 2) upper and lower spaced retainer rings 39 and 40 which are arranged intermediate swaging ring 21 and punch member 28 and swaging ring 25 and punch member 33, respectively. Upper ring 39 is formed with a series of bores 41 and aligned and enlarged counterbores 42 (one bore and one counterbore only being shown in Fig. 2), the inner face of each counterbore acting as a stop or a supporting shoulder for the enlarged head 43 of a shouldered bolt having a reduced intermediate shank 44 and a further reduced threaded section 45 which cooperates with its related internally threaded bore formed in flange 29 of punch member 28. By reason of the foregoing arrangement expander shoe assembly 38 is carried by and movable with punch holder 20 which, in turn, is operated by ram 19, and since heads 43 of the shoulder bolts are confined within counterbores 42, ring 39 as well as the remainder of the expander shoe assembly is adapted for limited motion relative to punch holder 20 for a purpose to appear hereinafter. The inner or lower face of ring 39 is formed with an inclined surface 46 for a purpose to also presently appear.

In a similar manner, lower retainer ring 40 is formed with an inner or upper inclined face or surface 47 and near its outer periphery is formed with a series of bores 48 and aligned counterbores 49, each pair of bores being axially aligned with a bore 50 formed in retainer ring 39. Tie rods 51 pass through each set of aligned bores 48, 49 and 50 whose enlarged heads 52 rest on the upper surface of ring 39 and whose lower ends are threaded to receive nuts 53 thereon. Coil springs 54 are sleeved on the lower ends of the tie rods with one end of each spring engaging the shoulder defined by the inner face of each counterbore 49 and the other end of each spring engaging a washer element 55 supported on nuts 53.

In addition to rings 39 and 40, assembly 38 also includes a series of radially arranged upper and lower substantially rectangular expander shoes 56 and 57 whose outer end walls engage, respectively, with the inclined inner surfaces 46 and 47 of rings 39 and 40. The inner walls of expander shoes 56 and 57, on the other hand, engage with the inclined outer walls of a series of radially arranged center shoes 58 and 59, respectively. The inner walls of center shoes 58 and 59 are level and normally in engagement as shown in Fig. 2.

In their ineffective position, i. e., one immediately preceding rib or runner pressing operation, expander shoes 56 and 57 and center shoes 58, 59 are located relative to each other and to the internal wall of a metal cylinder 60, in which the ribs or runners are to be formed, in a manner substantially as shown in Fig. 2. Center shoes 58, 59 are each provided with enlarged or aligned bores 61 and 62 adjacent their outer ends through which a related tie rod 51 passes, the bores 61 and 62 being of such nature as to permit limited outward motion of the center shoes relative to the tie rods against the action of garter springs 63 and 64 which rest within a series of arcuate and aligned recesses 65 and 66 formed substantially at the inner ends of shoes 58 and 59, respectively. Garter springs 63 and 64 normally maintain the center shoes 58 and 59 in a retracted position shown in Fig. 2 wherein an upper portion of an inner inclined end of cam surface 67 of each shoe 58 engages a lower portion of cam surface 32 of punch member 28 and wherein a portion of an inner inclined side of cam surface 68 of each shoe 59 engages a portion of cam surface 37 of punch member 33.

The outward end of cam surface 67 of each center shoe 58 terminates in a more sharply inclined relief surface 69 a portion of which defines one end of a rectangular slot 70 formed in each of the center shoes at the outer inclined wall thereof adjacent the lower engaging surface of expander shoes 56. Each slot 70 so formed receives a coil spring 71 therein, one end of each spring abutting the shoulder defined by the inner end of each slot and the opposite end of each spring abutting with shoulder portion 72 of a stud 73 supported within a bore 74 formed in each of expander shoes 56. By virtue of the foregoing arrangement, as garter spring 63 retracts center shoes 58 to their innermost position, under conditions to be presently described, springs 71 are compressed to thereby urge expander shoes 56 inwardly by way of studs 73 engaged by the springs, each expander shoe 56 being provided adjacent its outer end with a slot 75 surrounding each tie rod 51 to accommodate motion of each expander shoe relative to the tie rods. As will be apparent from the drawings, slots 75 are larger than slots 61 of the center shoes since the expander shoes must travel downwardly and outwardly a greater amount than the outward travel of the center shoes.

In a generally similar manner the outward end of cam surface 68 of each of center shoes 59 terminates in a more sharply inclined relief surface 76, a portion of which defines one end of a substantially rectangular slot 77 formed in each of the latter shoes at the outer inclined wall thereof adjacent the upper engaging surface of expander shoes 57. Each slot 77 defines a receptive chamber having a coil spring 78, one end of each spring abutting the shoulder defined by the inner end of each slot and the opposite end of each spring abutting with shouldered portion 79 of a pin 80 supported within a bore 81 formed in each of expander shoes 57. As garter spring 64 draws center shoes 59 to their innermost or retracted position, springs 78 are compressed to thereby urge expander shoes 57 inwardly by way of pins 80 engaged by the springs, each expander

shoe 57 being provided adjacent its outer end with a slot 82 surrounding each of tie rods 51 to accommodate motion of each of the latter expander shoes relative to the tie rods. Slots 82 are of the same size as slots 75 of expander shoes 56 since expander shoes 57 move upwardly and outwardly an amount exceeding the amount of outward movement by center shoes 59.

The innermost end of each expander shoe 56 is provided with an inclined or cam surface 83 for cooperation with cam surface 31 of punch member 28, surface 83 terminating in a more sharply inclined relief surface 84, while the inner end of each expander shoe 57 is provided with an inclined or cam surface 85 for cooperation with cam surface 36 of punch member 33, surface 85 terminating in a more sharply inclined relief surface 86. The outward ends of expander shoes 56 are provided with a spaced and downwardly inclined upper surface 87, a curved pressing end surface 88 and a downwardly inclined surface 89, better shown in the right hand side of Fig. 2, while the outward ends of expander shoes 57 are provided with a spaced and downwardly inclined upper surface 90, more sharply inclined than surface 87 of shoe 56, an intermediate curved pressing end surface 91 and a downwardly inclined surface 92 whose slope is somewhat smaller than that of surface 89 of shoes 56.

Swaging ring 25, whose width exceeds the width of swaging ring 21, is provided internally at its upper end with a circular groove or recess 93 whose side wall conforms generally with the configuration of a portion of the pressing end surface 91 and downwardly inclined surface 92 of each of expander shoes 57. In a similar manner, swaging ring 21 is provided internally at its lower end with a circular groove or recess 94 whose sidewall conforms generally with the shape of a portion of the pressing end surface 88 and downwardly inclined surface 87 of each of expander shoes 56.

In order that expander shoes 57 and center shoes 59 may not move outwardly preceding the time that expander shoes 56 and center shoes 58 will begin to move outwardly, a supporting arrangement is provided to prevent such premature action, such arrangement including an annular floating supporting plate 95 which is provided with a series of spaced apertures for receiving therein bolts 96. The lower ends of bolts 96 are threaded for cooperation with a series of spaced threaded bores 97 formed within flange 34 of punch member 33, the bolts being adjustable downwardly or upwardly as required relative to the retainer ring 40 by way of nuts 98. The upper portion of each bolt 96 is provided with enlarged head 99, and the heads of the bolts cooperate with a series of radially spaced bores 100 formed at the bottom of retainer ring 40. Coil springs 101 surround the bolts 96 with one end of each spring abutting a respective one of the nuts 98 and the other end of each spring resting within a recess 102 formed on the underside of plate 95. Thus, plate 95 is yieldably urged in an upward direction by way of spring 101.

Initially, ram 19 is in its upward or retracted position with swaging ring 21, expander shoe assembly 38 and punch member 28 held thereby away from lower swaging ring 25. At this point cylinder member 60 is placed in swaging ring 25 with its bottom end resting at substantially the junction point of recess 93 and a slightly inwardly inclined wall 103 of the ring, the lower end of which terminates in a shoulder 104, the remainder of the hollow ring being of a reduced diameter as shown in Fig. 2. With cylinder 60 supported in an upright position within ring 25, piston 15 is actuated to lower ram 19 together with the various operating mechanisms supported thereby. As upper swaging ring 21 approaches cylinder 60, the top end of the latter will initially engage with the interior of the ring at the junction of recess 94 and the slightly inwardly inclined wall 105 of the ring, the latter terminating in a shoulder 106, the remainder of the ring being of a reduced diameter as shown in Fig. 2. As cylinder 60 is engaged by swaging ring 21, the punch member 28 together with the expander shoe assembly 38 will have been lowered within cylinder 60 substantially as shown in Fig. 1.

By reason of its own weight, expander shoe assembly 38 will be supported by punch holder 20 through the engagement of the enlarged heads 43 of bolts 44 with the inner shoulder or face of counterbore 42 of ring 21. Since lower shoes 57 and 59 would engage cam surfaces 36 and 37 prior to engagement of upper shoes 56 and 58 with their related cam surfaces 31 and 32, floating plate 95 is provided to support the weight of the shoe assembly and thereby prevent expansion of the lower shoes prior to the time that the upper shoes will expand, it being important that outward expansion of the shoes occur at substantially the same time. Continuing downward motion of ram 19 subjects the top and bottom ends of cylinder 60 to a swaging operation so that the cylinder at its outer ends is formed with walls having gradually reduced diameters, such swaging operation continuing until the bottom and top cylinder ends engage with shoulders 104 and 106, respectively, of both swaging rings.

As the outer ends of cylinder 60 engage with shoulders 104 and 106, the outer and pressing faces of expander shoes 56 and 57 and center shoes 58 and 59 will assume a position, relative to the internal walls of cylinder 60, as shown in Fig. 2. At the same time there will be some relative motion between punch holder 20 and expander assembly 38 until bolts 44 are driven within their bores 42 to a position where flange 29 of punch member 28 engages the upper end of retainer ring 39. Thereafter, the punch member is moved downwardly towards punch member 33, cam surface 31 engaging with cam surface 83 of expander shoes 56 to move the latter downwardly and outwardly against a wall of cylinder 60, and simultaneously therewith cam surface 32 cooperates with cam surfaces 67 of center shoes 58 to drive the latter outwardly against the action of garter spring 63. At the same time, cam surface 37 cooperates with cam surface 68 of center shoes 59 to drive the latter outwardly against the action of garter spring 64 and cam surface 36 cooperates with cam surface 85 of lower expander shoes 57 to drive the latter upwardly and outwardly. As outward movement of the various expander shoes takes place, swaging ring 21 continues its downward motion so that as expander shoes 56 and 57 have been driven outwardly their maximum amount (as illustrated in Fig. 3) the upper portion of a rib or runner 107 formed on the cylinder by the expander shoes will be urged by expander shoes 56 into engagement with internal recess 94 of swaging ring 21 and a lower portion of a rib or runner 108 formed on the cylinder will

be urged by expander shoes 57 into engagement with internal recess 93 of swaging ring 25. In addition to swaging the ends of cylinder 60, rings 21 and 25 also help to sharpen the corners of the ribs or runners, a wall of the cylinder intermediate the runners being pressed outwardly as shown in Fig. 3, by center shoes 58 and 59.

As the cylinder walls ultimately formed into runners 107 and 108, are pressed outwardly, the cylinder is compressed inwardly lengthwise so that the final length of the cylinder is substantially less than its original length and as a result of such compression metal is caused to "flow" in the cylinder walls at the inclined surfaces 89 and 90 and 87 and 92 of expander shoes 56 and 57 so that desired sharp corners on the runners are obtained, the walls of the runners having substantially the same thickness as the remaining walls of the cylinder. By providing the upper expander shoes with downward and outward motion and the lower expander shoes with upward and outward motion, at the same time as pressure is applied by rings 25 and 21 coming together forcibly stretching of the metal of the cylinder walls is prevented which would otherwise occur if the shoes were expanded outwardly only and the squeeze were not coincidentally applied. Center shoes 58 and 59, on the other hand, provide a straight wall between the runners, such wall in the absence of the center shoes, otherwise assuming an undesirable curved form.

Subsequent to completion of the pressing operation whereby runners 107 and 108 are formed on cylinder 60, piston 15 is actuated to retract ram 19 and withdraw swaging ring 21 and punch member 28 from cylinder 60, expander shoe assembly 38 remaining in substantially the position of Fig. 3 until the enlarged heads 43 of bolts 44 engage with the inner faces of counterbores 42 to lift the expander shoe assembly. As cam surfaces 31 and 32 of punch member 28 move upwardly relative to expander shoes 56 and center shoes 58, garter spring 63 contracts to retract shoes 58 whereupon expander shoes 56 are likewise retracted by way of springs 71 and studs 73. During the same interval, expander shoes 57 and center shoes 59 move upwardly relative to cam surfaces 36 and 37 so that garter spring 64 contracts to retract center shoes 59 whereupon the latter, by way of springs 78 and pins 80, retract expander shoes 57. As the expander shoe assembly 38 clears cylinder 60, the latter may be removed and a plain straight walled cylinder is again inserted within swaging ring 25 and the rib or runner forming and pressing operation is repeated.

While expander shoe assembly 38 has been shown as supported by the punch holder for movement therewith through the agency of the shoulder bolts it is to be understood that the expander shoe assembly may be supported by the die shoe 24 in which event the assembly would be arranged within the swaging ring 25 and secured by suitable means such as bolts, for example, to floating pad or plate 95.

Cylinder 60 with the runners 107 and 108 formed thereon is removed from the press and thereafter mounted on a novel rolling machine whereby the outer ends of the runners are rolled and compressed inwardly to provide a greater amount of metal at the outer ends of the runners from that present in the walls of the cylinder. The rolling machine, as more clearly shown in Fig. 7, comprises a table or platform 109 supported on a bed plate 110 by way of spaced supporting members 111 and 112. Table 109 is centrally recessed to receive and support therein a hollow bearing housing 113 whose bottom end plate 114 is fastened to one end of a hollow tubular shaft 115, the other end of the latter being connected to top plate 116 of a gear housing 117 supporting bearings 118 therein, which journal the lower end of a hollow spindle 119, the upper end of the spindle being journaled within bearings 120 supported within housing 113.

The bottom end of spindle 119 is journaled within a bearing 121 carried by the gear housing and has a reduced threaded portion engaged by a lock nut 122 maintaining a worm wheel or gear 123 thereon, the latter being fastened to the reduced end of the spindle by way of splines 124. Worm wheel or gear 123 is in mesh with a worm 123a (Fig. 5) carried by a shaft 125 supporting a pulley 126 thereon, the latter being driven through a belt drive by a motor (not shown) in a conventional manner. Operation of the motor will therefore result in rotation of spindle 119 for a purpose to presently appear.

Spindle 119 is generally conical in shape and at its top end has an extending flange or plate 127 formed integrally therewith, the underside of the plate bearing within a shouldered recess formed at the top of housing 113. Secured to plate 127 for rotation with spindle 119 by way of bolts 128 is a chuck 129 provided with a central opening 130 and having a series of spaced radial recesses 131 and 132 formed therein. Recesses 131 slidably receive therein a series of radially expanding jaws 133 having their inner ends fastened to plungers 134 whose free ends carry inclined or cam surfaces 135 for cooperation with a cam member 136 having an inclined surface 137. Recesses 132, on the other hand, slidably receive therein a series of radially expanding jaws 138 having their inner ends fastened to plungers 139 whose free or inner ends carry inclined or cam surfaces 140 for cooperation with a cam member 141 having an inclined surface 142, cam member 141 being spaced from cam member 136 and both members being secured to a draw bar or rod 143 by way of keys 144 and 145, respectively. Draw bar or rod 143 is telescopically mounted within spindle 119 for a purpose to presently appear.

The outer ends of expanding jaws 133 are provided with upper and lower curved surfaces for engaging the inner side walls of rib or runner 107 of cylinder 60, such surfaces terminating at their inner ends in grooves 146 which define receptive chambers for a return or garter spring 147 which is annular in form and which urges jaws 133 in an inward direction when cam member 136 has been raised upwardly relative to inclined surfaces 135 of plungers 134. In a generally similar manner, the outer ends of expanding jaws 138 are provided with upper and lower curved surfaces for engaging the inner side walls of ribs or runners 108 of cylinder 60, the latter surfaces terminating at their inner ends in grooves 148 which define receptive chambers having a return or garter spring 149 which is annular in form and which urges jaws 138 in an inward or retracted position when cam member 148 has been raised upwardly relative to inclined surfaces 140 of plungers 139.

The upper portion of chuck 129 has a series of spaced radial recesses 150 formed therein slidably receiving plungers 151 which carry retainer jaws 152 at their outer ends for engaging with the top end of cylinder 60 and thereby main-

taining the cylinder on the chuck, the bottom of the cylinder being maintained in engagement with a supporting shoulder 153 of a ring 154 which is fastened by way of screws 155 to the side wall of the chuck. Plungers 151 at their inner ends are formed with inclined surfaces 156 for cooperation with cam surfaces 157 of a cam member 158 secured by way of a key 159 to the top of draw bar or rod 143. Retainer jaws 152 at their outer ends are provided with grooves 160 which receive a return or garter spring 161, the latter urging the retainer jaws inwardly to disengage from the top of cylinder 60 when cam 158 has been moved upwardly. The opening at the top of chuck 129 may be closed by a suitable dust cover 162, the latter being large enough to accommodate the required upward motion of draw bar 143 therein.

The bottom end of draw bar 143 supports a bearing housing 163 thereon having a circumferential groove 164 formed therein with which cooperates a pin 165 carried by a yoke member 166 supported at one end of a lever 167, the lever being pivotally mounted at a substantially central portion thereof on the spaced arms of a bracket 168 by way of a pin 169. The opposite end of lever 167 is connected by way of a pin 170 with a piston rod 171 carrying a piston thereon (not shown) which is reciprocally movable within a cylinder 172. The cylinder, in turn, carries spaced arms 173 and 174 thereon which pivotally mount the cylinder by way of a pin 175 on a bracket 176 fastened by way of bolts 177 to side member 112.

At the same time that cylinder 60 is inserted on chuck 129, draw bar 143 will have been moved upwardly by piston rod 171 so that cam members 136, 157 and 158 will have been moved upwardly relative to plungers 134, 149 and 151 so that garter springs 147, 149 and 161 will have drawn the expanding and retainer jaws inwardly so that the cylinder will clear the latter as the bottom of the cylinder is brought to rest on shoulder 153 of ring 154. In this assembled condition the grooves 146 of jaws 133 and grooves 148 of jaws 138 are substantially aligned with the apices of runners 107 and 108, respectively.

As draw bar 143 is actuated downwardly, cam members 136 and 141 move downwardly to expand jaws 133 and 138 radially and outwardly to engage with the inner side wall of the runners and thus hold the cylinder thereon. At the same time cam 158 moves downwardly to move retainer jaws 152 outwardly and over the top of the cylinder to retain the latter on the chuck. The chuck, in turn, is rotated by spindle 119, in a manner to presently appear, to rotate the cylinder 60 therewith.

The outer side walls and the apex of runner 107 of cylinder 60 are adapted for engagement by a roller 178 having an upper curved wall 179 and a lower curved wall 180, the curvature of the former wall being greater than the curvature of the latter wall, wall 179 engaging with the top side wall of runner 107 and wall 180 engaging with the bottom side wall of the runner. In the same manner the outer side walls and the apex of a runner 108 of the cylinder are adapted for engagement by a roller 181 having an upper curved wall 182 and a lower curved wall 183, the curvature of the former being less than the curvature of the latter wall, wall 182 engaging with the top side wall of runner 108 and wall 183 engaging with the bottom side wall of the runner.

Roller 178 is mounted by way of a stub shaft 184 within a bracket 185 (see Fig. 5) the bracket being pivotally connected by way of a pin 186 and an arm 187 to one end of a supporting member 188. When adjustment of roller 178 on bracket 185 is required, the lower portion of the bracket may have a bore 189 (Fig. 6) formed therein for the reception of a hollow pin 190 which is yieldably urged by way of a spring 191 into engagement with a wall of supporting member 188. A second and aligned bore is threaded for adjustably receiving therein a threaded stub shaft 192, the latter carrying a pin 193 about which one end of spring 191 is sleeved to abut with an outer face of shaft 192. Rotation of shaft 192 therefore will actuate pin 190 to position bracket 185 relative to member 188 as desired. To define a limit for outward motion of pin 190 within bore 189, the pin may be provided with an enlarged head 194.

Roller 178 is in engagement with a larger roller 195 at a point diametrically opposite to the point of engagement with runner 107 and in a similar manner, roller 181 is in engagement with a larger roller 196. Inasmuch as the mounting and operation of both rollers 195 and 196 is the same, the operation of only one of the rollers will be considered in detail herein.

Roller 195 is mounted for rotation within a bearing housing 197 by way of a stub shaft 198, the housing being fastened to and movable with a block 199 which is slidable on a stationary member 200 secured to supporting member 188, the latter, in turn, having an enlarged flange through which pass bolts 201 for securing the stationary member to member 188. A portion of movable block 199 is provided with a recess 202 with which cooperates the rounded end of one arm of a bellcrank lever 203, the lever being pivotally mounted by way of a transverse pin 204 carried within a recessed portion 205 of stationary member 200. The opposite arm of bellcrank 203 is connected by way of a pivot pin 206 journaled in a yoke 207 which is fastened by way of bolt 208 to a piston rod 209 for up and down movement by the latter. Piston rod 209 is adapted for operation by a piston (not shown) movable within a cylinder 210, the base of the cylinder being pivotally mounted by way of a pin 211 and a block 212 on a supporting standard or bracket 213 fastened by way of bolts 214 to wall 112. Cylinder 210 is enclosed within a protective housing 215 which passes under and to the side of movable block 199 (Fig. 7), the movable block supporting thereon by way of screws 216, a protective cover 217 so that block 199 may move relative to housing 215 and still maintain the latter closed by means of cover 217. The upper portion of cylinder 210 supports a clock or timer mechanism 218 thereon by way of a bracket 219.

When cylinder 60 is inserted on the chuck 129, draw bar 143 is in an upward position (indicated by broken line 220 of Fig. 7) so that expanding jaws 133 and 138 as well as retainer jaws 152 have been retracted to their inward position. As cylinder 60 has been lowered on the chuck sufficiently to rest the bottom thereof on shoulder 153 of ring 154, draw bar 143 is moved downwardly by piston rod 171 which is moved upwardly within cylinder 172, the latter being pivotally mounted by pin 175 to compensate for the arcuate path of travel of the end of lever 167 connected to the piston rod. Downward motion of the draw bar causes downward movement of cam member 158 whose surface 157 cooperates with surface 156 of plungers 151 to extend the re-

tainer jaws 152 against the action of spring 161 over the top end of the cylinder to retain the latter against shoulder 153. In addition, cam members 136 and 141 move downwardly so that their inclined surfaces 137 and 142 cooperate with inclined surfaces 135 and 140 of plungers 134 and 139 to extend jaws 133 and 138 against the action of springs 147 and 149 into engagement with the inner side walls of runners 107 and 108 as shown in Fig. 7. Cylinder 60 is thus locked with chuck 129 for rotation thereby.

The motor (not shown) for driving pulley 126 and shaft 125 is thereupon energized to operate worm gear 123 and spindle 119. The spindle being connected to chuck 129 rotates the latter whereupon cylinder 60 is rotated by the chuck through expanding and retainer jaws 133, 148 and 152. The side walls 179 and 180 of roller 178 being in engagement with the lower and upper side walls of runner 107 and side walls 182 and 183 of roller 181 being in engagement with the top and bottom walls of runner 108, rolling of both rollers 178 and 181 occurs, it being noted that at this point rollers 178 and 181 are both slightly spaced from the apices of their related runners. As cylinder 172 operates to actuate draw bar 143 and the motor is energized to spin the spindle and the cylinder 60, cylinder 210 operates to move piston rod 209 upwardly whereupon bellcrank 203 is pivoted to move block 193 and roller 195 therewith to the left to engage roller 178 and thereby move the latter against cylinder 60 until roller 178 engages with the apex of runner 107. Continued inward movement of the roller by the bellcrank compresses the apex of the runner inwardly to flatten the apex of the runner so that as a result of such compression, the inner walls of the runners being supported by jaws 133, the thickness of the runner at the apex thereof will be increased to provide the runner with a greater amount of metal thereat than that present at the side walls of cylinder 60. As an example, with the above described rolling machine the thickness of the apices of the runners so formed on a cylinder having a wall thickness of .060 inch will increase to between .084 to .090 inch which represents an increase over the original thickness of forty (40) to fifty (50) per cent.

In operation, a button (not shown) is depressed to actuate the piston of cylinder 172 so that draw bar 143 is pulled downwardly to actuate cams 136, 141 and 158 to expand jaws 133, 148 and 152 outwardly. As draw bar 143 moves downwardly it closes an electrical switch which not only energizes the electrical motor for rotating chuck 129 and cylinder 60 therewith but also operates two reversing air valves (not shown) to operate the pistons of cylinder 210 and the corresponding cylinder of roller 196. Air is thus caused to communicate with the lower side of the pistons while oil or other hydraulic fluid communicates with the upper side of the pistons, a bleed being provided for each cylinder so that the fluid escapes at a metered rate whereby both piston rods travel upwardly at a uniform rate to move rollers 178, 195 and 181, 196 inwardly at a uniform rate. Electrical clock or timer 218 controls the time of the rolling operation and the lower end of an adjustable bolt 221 defines a limit stop for movement of piston rod 209 and a similar timer and limit stop control the piston rod of roller 196. Shortly after the piston rods engage with the limit stops indicating the limit of inward roller motion, mechanism 218 acts to reverse the air valves whereupon the rollers are retracted from cylinder 60, piston rod 171 of cylinder 172 is reversed to move the draw bar upwardly whereby springs 147, 149 and 161 retract jaws 133, 136 and 152 inwardly and the motor driving the chuck is deenergized. The cylinder is removed from the rolling machine and replaced by another similar cylinder whose runners, formed on the press, are to be rolled and compressed inwardly.

As will be apparent from Fig. 5, rollers 178 and 181, while arranged at diametrically opposite points relative to chuck 129 to engage each runner at opposite sides of the cylinder are so arranged that one of the rollers is mounted at one side of the center of the chuck while the other roller is mounted at an opposite side of the center of the chuck. By reason of this latter mounting the rollers are prevented from dislodgment from their desired position by the spinning cylinder with which they engage.

There has thus been provided a novel apparatus for forming ribs or runners on a metal cylinder comprising a press which not only forms the runners on the cylinder but also swages the ends of the cylinder together with a rolling machine for compressing the apices of the runners inwardly to provide a thickness of material at the apices of the runners which is greater than the thickness of the metal in the walls of the cylinder.

Although but a single embodiment of the present invention has been illustrated and described in detail, it will be expressly understood that the invention is not limited therto. Various changes may be made in the design and arrangement of the parts without departing from the spirit and scope of the invention as will now be understood by those skilled in the art.

What is claimed is:

1. A press for forming outwardly projecting circumferential runners on a cylinder comprising a bed plate, a hollow swaging ring fastened to said bed plate, a movable punch holder, means for moving said punch holder to and from said bed plate, a second hollow swaging ring disposed opposite said first swaging ring and movable relative thereto with said holder, said swaging rings having tapered internal surfaces adapted to engage and correspondingly taper the end portions of a hollow cylindrical form, a shoulder formed within each of said rings, expansible means carried by said holder adapted for pressing walls of the cylinder outwardly, said first swaging ring being adapted for supporting one end of said cylinder therein the opposite end of which is engaged by said second swaging ring during motion by the latter relative to said first swaging ring to swage the ends of the cylinder, said cylinder engaging with the shoulders of said rings upon completion of said swaging operation and in response to continued movement of said second swaging ring said cylinder is compressed lengthwise by said second ring, said expansible means being operated to press the walls of the cylinder outwardly as the cylinder is compressed lengthwise, and means for moving said holder.

2. A barrel-forming apparatus comprising a bedplate, a ram movable to and from said bedplate, a pair of spaced swaging rings carried by said bedplate and said ram respectively disposed in opposed coaxial relation and adapted to engage opposite ends of a hollow cylindrical form, said rings having oppositely tapered internal surfaces and movement of the ram toward the bed-

movement of the swaging rings toward each other coactive with said pressure shoes to force the same radially against the form simultaneously with movement of the form into said rings.

9. A press comprising a bedplate, a swaging ring secured to said bedplate, a movable punch holder above said bedplate, means for moving said punch holder to and from said bedplate, a second swaging ring disposed opposite said first swaging ring carried by and movable with said holder, said swaging rings having tapered internal surfaces adapted to engage and correspondingly taper the end portions of a hollow cylindrical form, a hollow expander assembly carried by and mounted for limited movement relative to said holder internally of said second ring and having radially movable expander shoes, cam means mounted on said bedplate and on said punch holder internally of said shoe assembly coactive with said expander shoes to expand the same radially outwardly against said form, yieldable means for holding said expander shoes normally retracted, and means for moving the retracted expander shoes against said cam means to project the latter against said form.

10. A press comprising a bedplate, a swaging ring secured to said bedplate, a movable punch holder, means for moving said punch holder to and from said bedplate, a second swaging ring on said holder opposite said first swaging ring, said swaging rings having tapered internal surfaces adapted to engage and correspondingly taper the end portions of a hollow cylindrical form, means comprising an annular series of spaced, radially movable expander shoes, means connecting said shoes to said holder for limited movement relative to said holder, means for yieldably maintaining said shoes in a retracted position, said shoes being movable in an inclined plane and being provided with cam surfaces at their inner ends, and cam means carried by said holder centrally of said shoes and engageable thereby upon movement thereof relative to said holder, said cam means being operative upon such engagement to force said shoes to an extended position.

11. A press comprising a bedplate, a swaging ring secured to said bedplate and provided with a tapered, internal swaging surface, a movable punch holder, means for moving said punch holder to and from said bedplate, a second swaging ring on said holder opposite said first swaging ring and similarly provided with a tapered internal swaging surface, said swaging rings adapted to receive opposite end portions of a hollow cylindrical form and movable against said end portions to taper the same in accordance with the internal tapered surfaces of the rings, means comprising a first annular series of spaced, radially movable shoes, said shoes being provided with inclined surfaces and having cam surfaces at their inner ends, means comprising a second annular series of spaced, radially movable shoes, said last-mentioned shoes being movable on the inclined surfaces of said first-named shoes and having cam surfaces at their inner ends, means yieldably maintaining all of said shoes in a retracted position, means connecting said first and said second series of shoes to said holder and adapting all of said shoes for movement relative to said holder, and cam means carried by said holder centrally of said shoes and engageable by the shoes upon movement thereof relative to said punch holder, said cam means being operative by reason of such engagement to move all of said shoes simultaneously to an extended position.

12. A press for forming an outwardly extending runner on a metal cylinder comprising a bedplate, a swaging ring secured to said bedplate and adapted to receive one end of the cylinder therein, a movable punch holder, a second swaging ring on said holder opposite said first swaging ring adapted to receive the opposite end of the cylinder, means for moving the punch holder toward the bedplate to force the swaging rings over the end portions of the cylinder so as to conform the engaged portions of the cylinder to the internal form of the swaging rings, an expander shoe assembly carried by and movable for a limited distance relative to the holder disposed centrally of said swaging rings and movable into the cylinder by said holder, cam means carried by the bedplate and punch holder respectively coactive with the expander shoe assembly to expand said shoe assembly against an internal wall of the cylinder to form an outwardly extending runner thereon.

13. A press comprising a bedplate, a hollow swaging ring secured to said bedplate, a movable punch holder, means for moving said punch holder to and from said bedplate, a second swaging ring carried by said holder and disposed opposite said first swaging ring, said swaging rings having tapered internal surfaces adapted to engage and correspondingly taper the end portions of a hollow cylindrical form, means comprising an expander shoe assembly fastened to said holder for movement thereby and adapted for limited motion relative thereto, yieldable supporting means maintained within said first swaging ring for engaging and supporting said assembly when the latter has been moved by said holder, said assembly comprising a first annular series of spaced radially movable shoes, a second annular series of spaced radially movable shoes concentrically arranged with said first shoes, the inner walls of both series of shoes being level and the opposite walls thereof being inclined, a third annular series of spaced, radially movable shoes movable on the inclined walls of said first series of shoes, a fourth annular series of spaced radially movable shoes movable on the inclined walls of said second series of shoes, yieldable means retracting all of said shoes inwardly, cam members carried by the bedplate and punch holder centrally of said shoes having cam surfaces engageable by the shoes when the punch holder is moved toward the bedplate and operative by such engagement to move the shoes radially outwardly.

References Cited in the file of this patent

UNITED STATES PATENTS

Number	Name	Date
1,011,193	Hackney	Dec. 12, 1911
1,039,886	Bauroth	Oct. 1, 1912
1,058,669	Goddard	Apr. 8, 1913
1,285,982	Goddard	Nov. 26, 1918
1,698,999	Hothersall	Jan. 15, 1929
2,082,199	Dake	June 1, 1937
2,089,476	Grotnes	Aug. 10, 1937
2,142,017	Riemenschneider et al.	Dec. 27, 1938
2,153,863	Fall	Apr. 11, 1939
2,158,312	Terrell	May 16, 1939
2,211,009	Grotnes	Aug. 13, 1940
2,307,191	Bell	Jan. 5, 1943
2,384,324	Martin	Sept. 4, 1945
2,398,373	Grotnes	Apr. 16, 1946

FOREIGN PATENTS

Number	Country	Date
149,442	Great Britain	Aug. 16, 1920

plate serving to force said surfaces over the engaged end portions of the form to progressively reduce the circumference of said engaged portions toward the ends thereof, a hollow expander shoe assembly also carried by and movable for a limited distance relative to the ram disposed centrally of said swaging rings and movable by the ram into the form when the latter is engaged with the rings, said assembly including two annular series of radially adjustable shoes adapted for engagement with the form and located to engage the form substantially equidistantly on opposite sides of the middle thereof, and cam means carried by the bedplate and ram respectively engageable with respective series of shoes when the ram is actuated to force the rings over the ends of the form and operative by such engagement to force the shoes radially outwardly against the form whereby axially compressible and radially expansive forces are exerted simultaneously on the form to swage the ends thereof and to provide radially outwardly projecting hollow runners extending circumferentially entirely around the form.

3. A barrel-forming apparatus comprising a bedplate, a ram movable to and from said bedplate, a pair of spaced swaging rings carried by said bedplate and said ram respectively disposed in opposed coaxial relation and adapted to engage opposite ends of a hollow cylindrical form, said rings having oppositely tapered internal surfaces and movement of the ram toward the bedplate serving to force said surfaces over the engaged end portions of the form to progressively reduce the circumference of said engaged portions toward the ends thereof, a hollow expander shoe assembly disposed centrally of said swaging rings, means fastening said expander shoe assembly to said ram permitting limited movement of the assembly relative to the ram, said expander shoe assembly being movable by the ram into the form when the latter is engaged with the rings, said assembly including expansible means engageable with the form to expand the engaged portion of the form, and means rendered operative by movement of the ram toward the bedplate and by relative movement between the expander shoe assembly and the ram to force the expansible means against the form.

4. A barrel-forming apparatus comprising a bedplate, a ram movable to and from said bedplate, a pair of spaced swaging rings carried by said bedplate and said ram respectively disposed in opposed coaxial relation and adapted to engage opposite ends of a hollow cylindrical form, said rings having oppositely tapered internal surfaces and movement of the ram toward the bedplate serving to force said surfaces over the engaged end portions of the form to progressively reduce the circumference of said engaged portions toward the ends thereof, a hollow expander shoe assembly disposed centrally of said swaging rings, means fastening said expander shoe assembly to said ram permitting limited movement of the assembly relative to the ram, said expander shoe assembly being movable by the ram into the form when the latter is engaged with the rings, said assembly including two annular series of radially slidable shoes positioned engageable with the form at axially spaced points therealong and another annular series of radially expansible shoes positioned to engage the form intermediate said spaced points, and actuator means for said shoes rendered operative by movement of the ram and by movement of the shoe assembly relative to the ram to press the shoes simultaneously outwardly against the form.

5. A barrel-forming apparatus including a pair of spaced pressure members arranged in opposed relation and adapted to engage opposite ends of a hollow cylindrical form, means for moving at least one of said pressure members in the direction of the other pressure member to exert endwise pressure against said form, an expander shoe assembly, means mounting said expander shoe assembly on one of said pressure members for limited movement relative thereto, said assembly being so located on the pressure member as to be insertible into said form, said assembly including an annular series of pressure shoes movable generally radially into engagement with said form intermediate the ends thereof, and cam means engageable with said pressure shoes for forcing the same simultaneously against said form, and means co-ordinating movement of said pressure members and said cam means for simultaneous operation so that endwise and radial pressures are exerted simultaneously against said form to collapse the material thereof engaged by said shoes and to form a continuous annular rib or runner in the form.

6. A barrel-forming apparatus including a pair of spaced pressure members arranged in opposed relation and adapted to engage opposite ends of a hollow cylindrical form, means for moving at least one of said pressure members in the direction of the other pressure member to exert endwise pressure against said form, a hollow expander shoe assembly carried by and movable with one of said pressure members positioned to enter the form when the pressure members are actuated to engage the ends of the form, means fastening said expander shoe assembly to said one pressure member providing for limited relative movement therebetween, and means carried by said pressure members for actuating said expander shoe assembly when endwise pressure is exerted against said form.

7. A barrel-forming apparatus comprising spaced, swaging rings having internal cavities and disposed in opposed coaxial relation adapted to receive opposite end portions of a hollow cylindrical form and to conform the engaged portions of the form to the shape of said rings, means for moving one of said swaging rings toward the other so as to force the ends of the form into the rings, a hollow expander shoe assembly coactive with said movable swaging ring and positioned to enter the form when the swaging ring is engaged therewith, and cam members positioned to be within said form and coactive with said expander shoe assembly, said cam members being rendered operable by movement of the swaging rings toward each other to actuate said hollow expander shoe assembly against said form and to project the latter into the internal cavities of said swaging rings so as to provide a radially outwardly extending annular runner on the form.

8. A barrel-forming apparatus comprising spaced swaging rings disposed in opposed coaxial relation adapted to receive opposite end portions of a hollow cylindrical form and to conform the engaged portions of the form to the shape of said rings, means for moving one of said swaging rings toward the other so as to force the ends of the form into the rings, an annular series of pressure shoes positioned to move generally radially against the form, and means actuated by