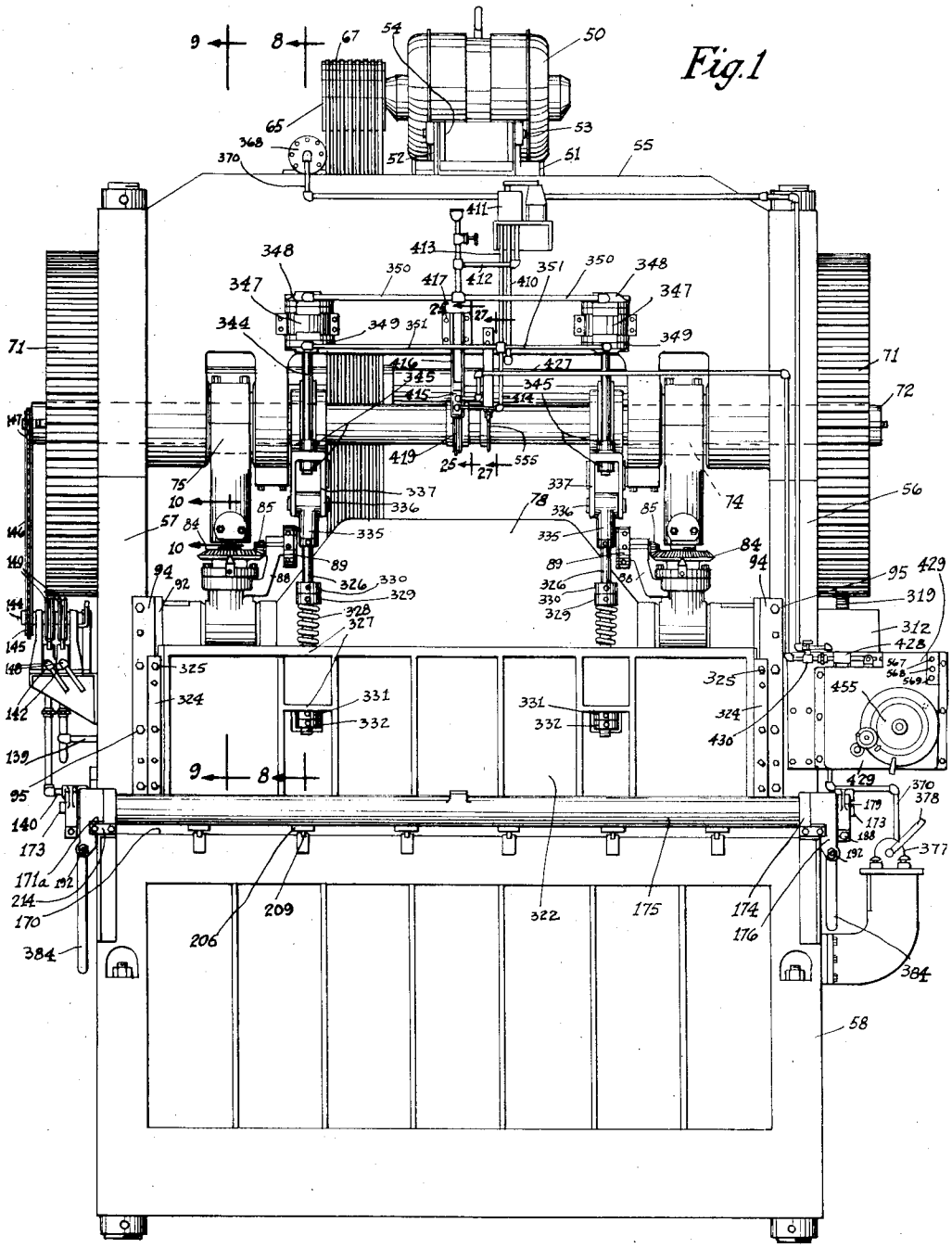
June 3, 1941. W. M. McNEIL ET AL 2,244,305

MACHINE FOR PRODUCING EXPANDED METAL

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Fig. 1



INVENTOR
WILLIAM M. McNEIL
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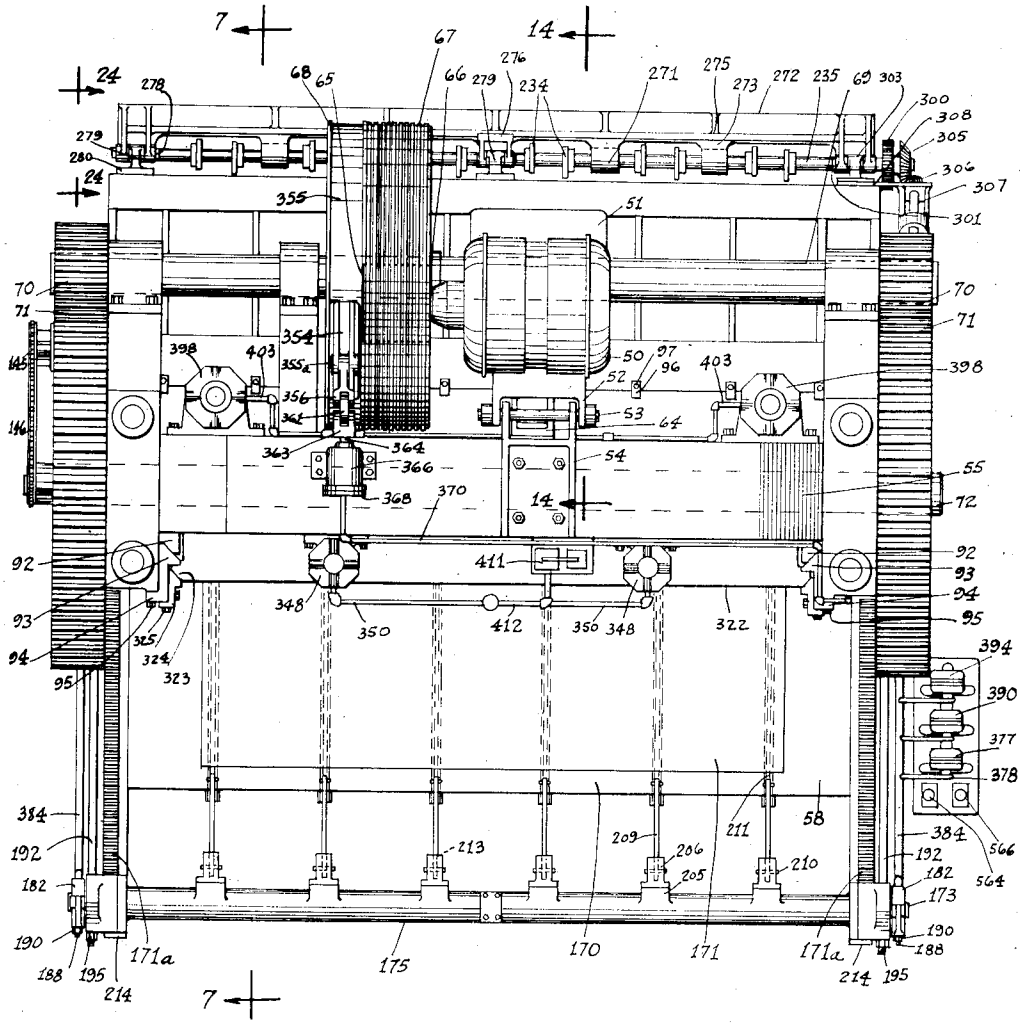
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MACHINE FOR PRODUCING EXPANDED METAL

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Fig. 2



INVENTOR
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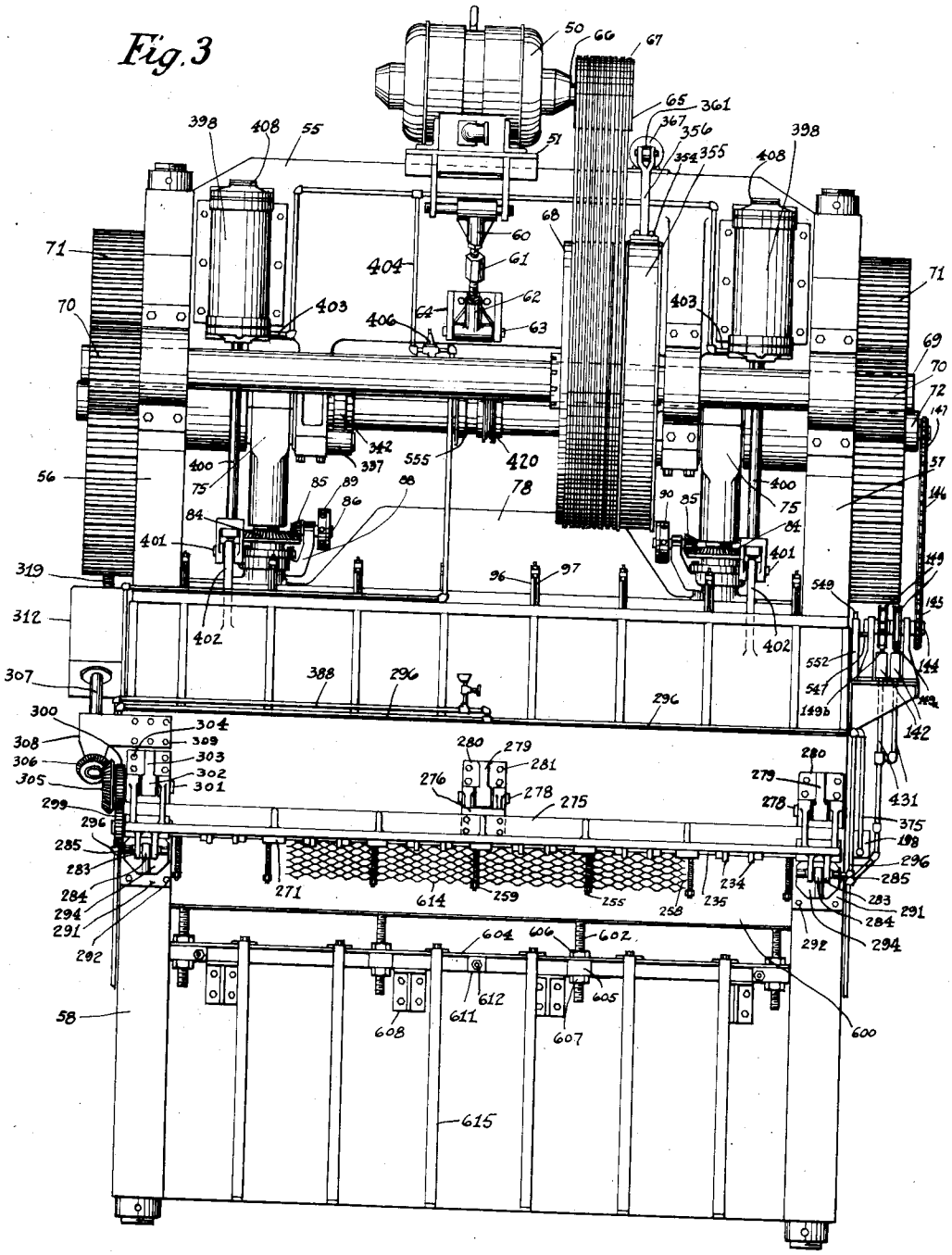
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MACHINE FOR PRODUCING EXPANDED METAL

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Fig. 3



INVENTOR
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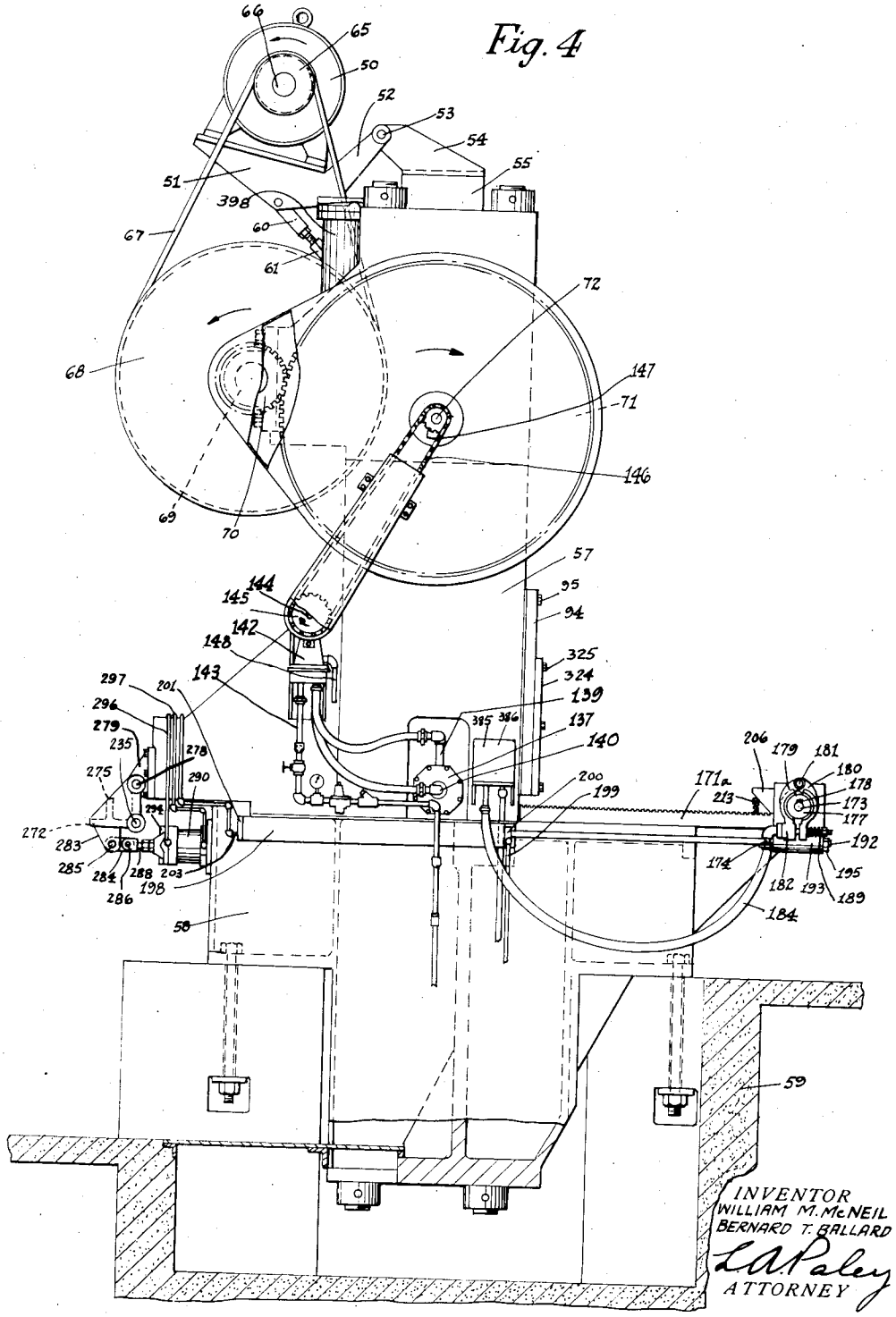
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MACHINE FOR PRODUCING EXPANDED METAL

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Fig. 4



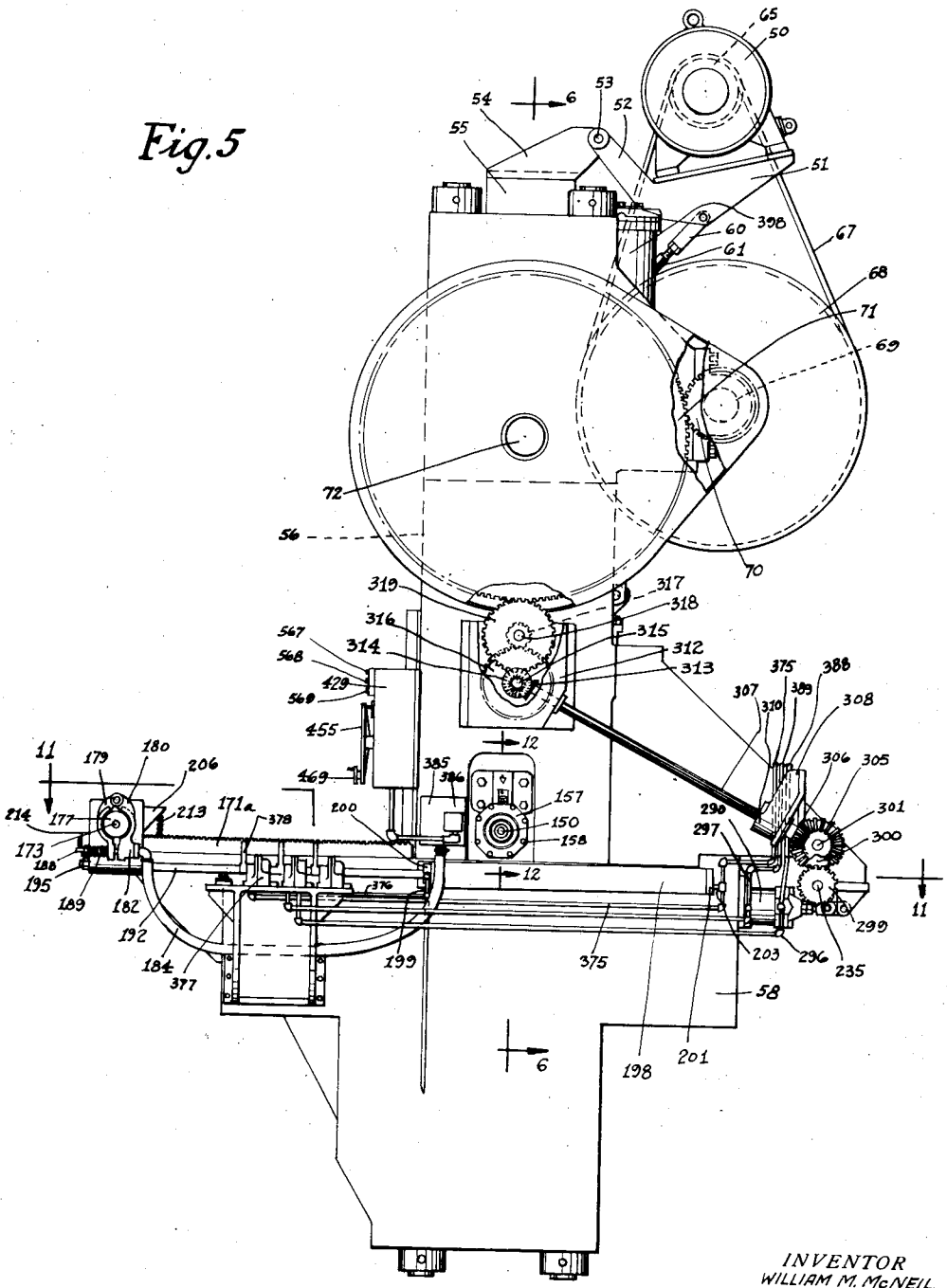
INVENTOR
WILLIAM M. McNEIL
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MACHINE FOR PRODUCING EXPANDED METAL

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Fig. 5



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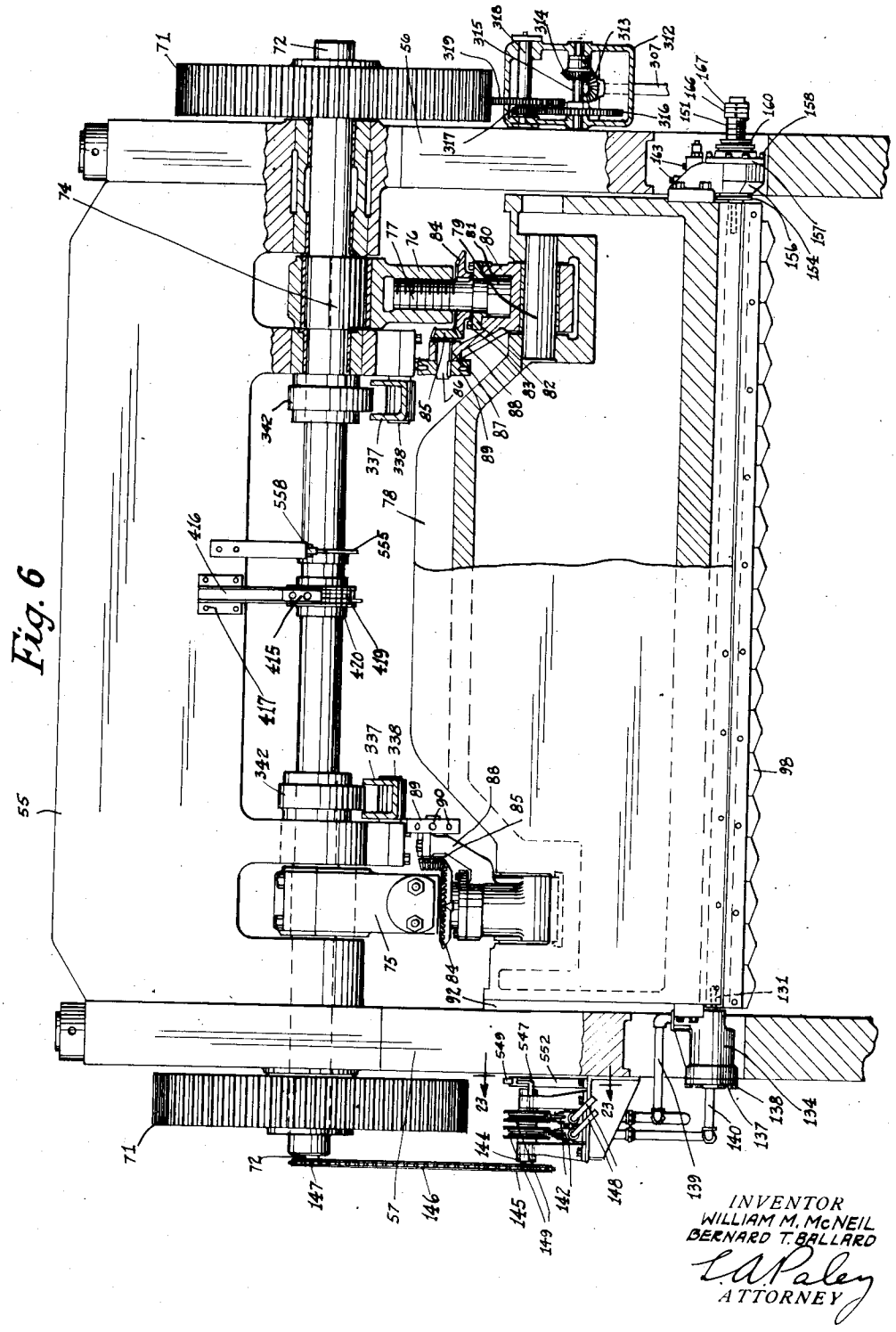


Fig. 6

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MACHINE FOR PRODUCING EXPANDED METAL

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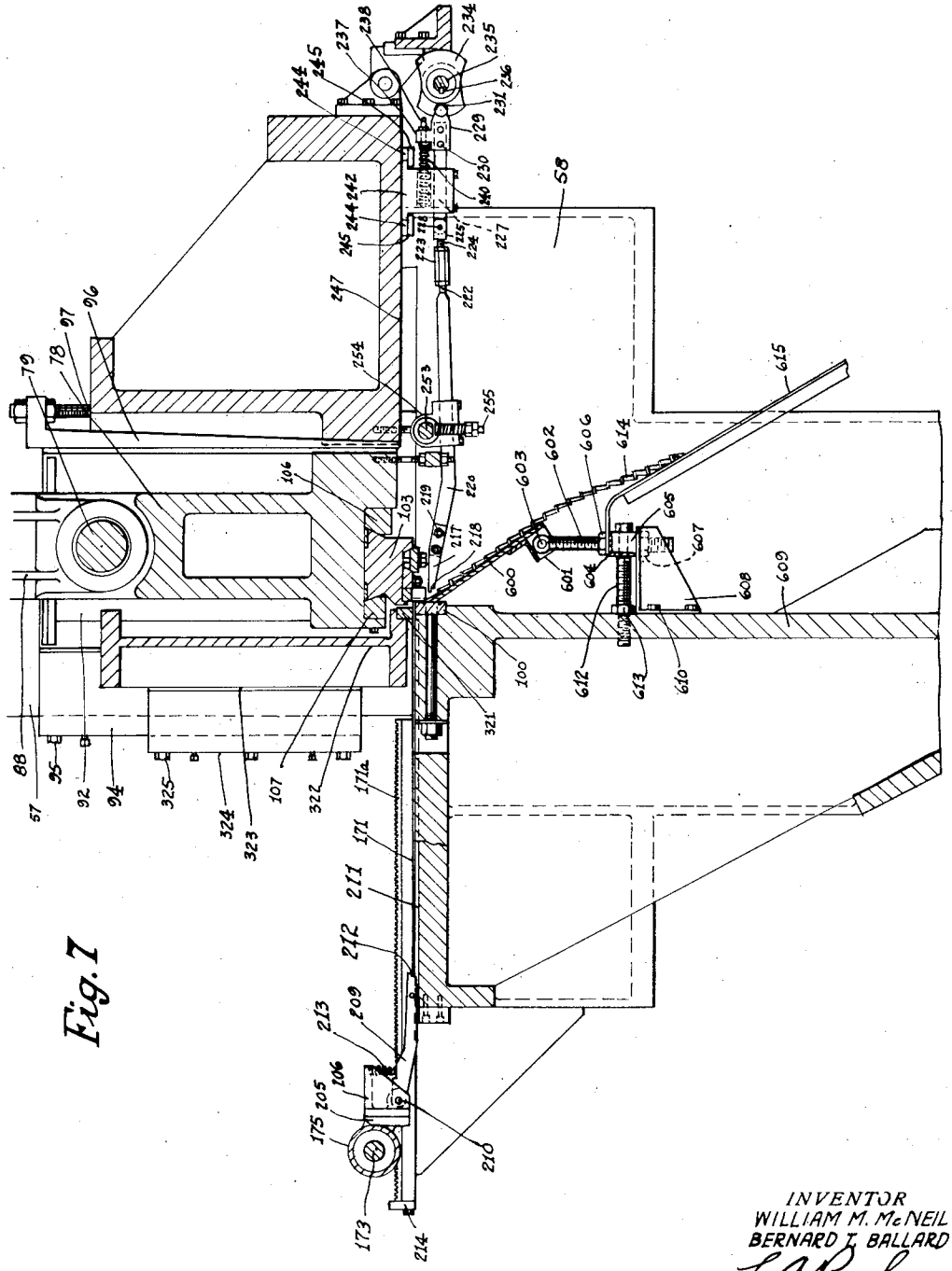


Fig. 7

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MACHINE FOR PRODUCING EXPANDED METAL

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Fig. 8

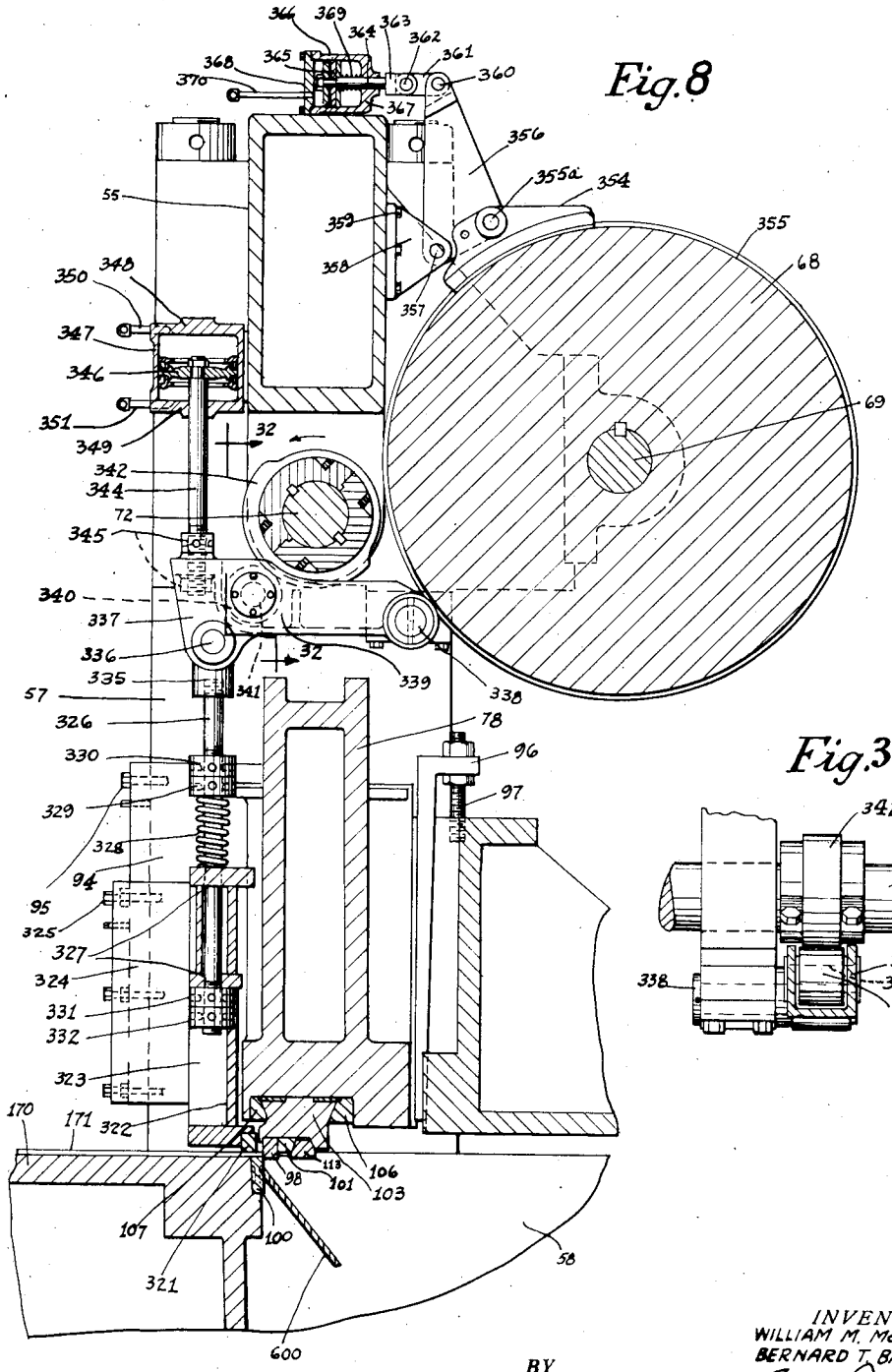


Fig. 32

BY

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MACHINE FOR PRODUCING EXPANDED METAL

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Fig. 9

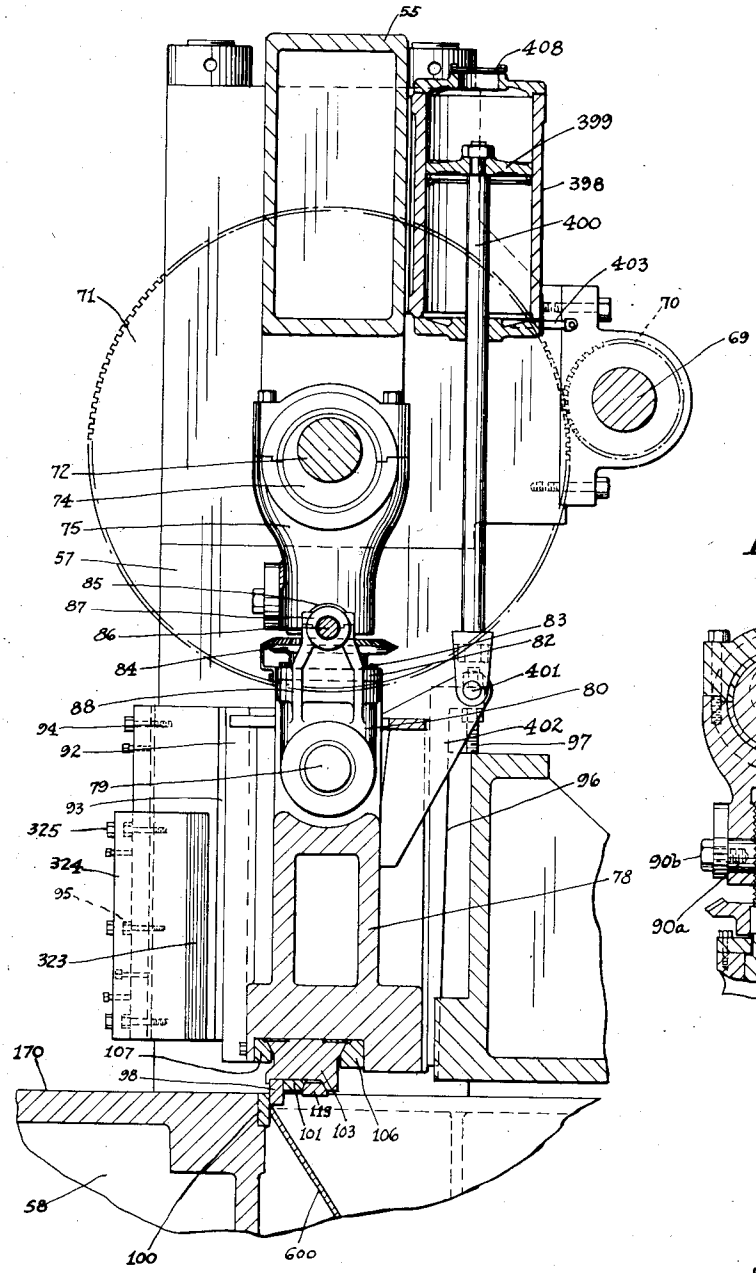
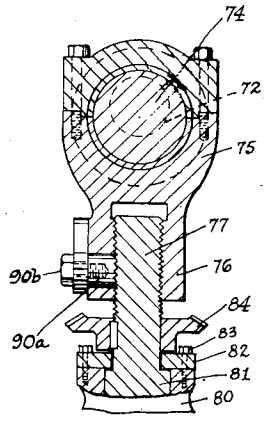


Fig. 10



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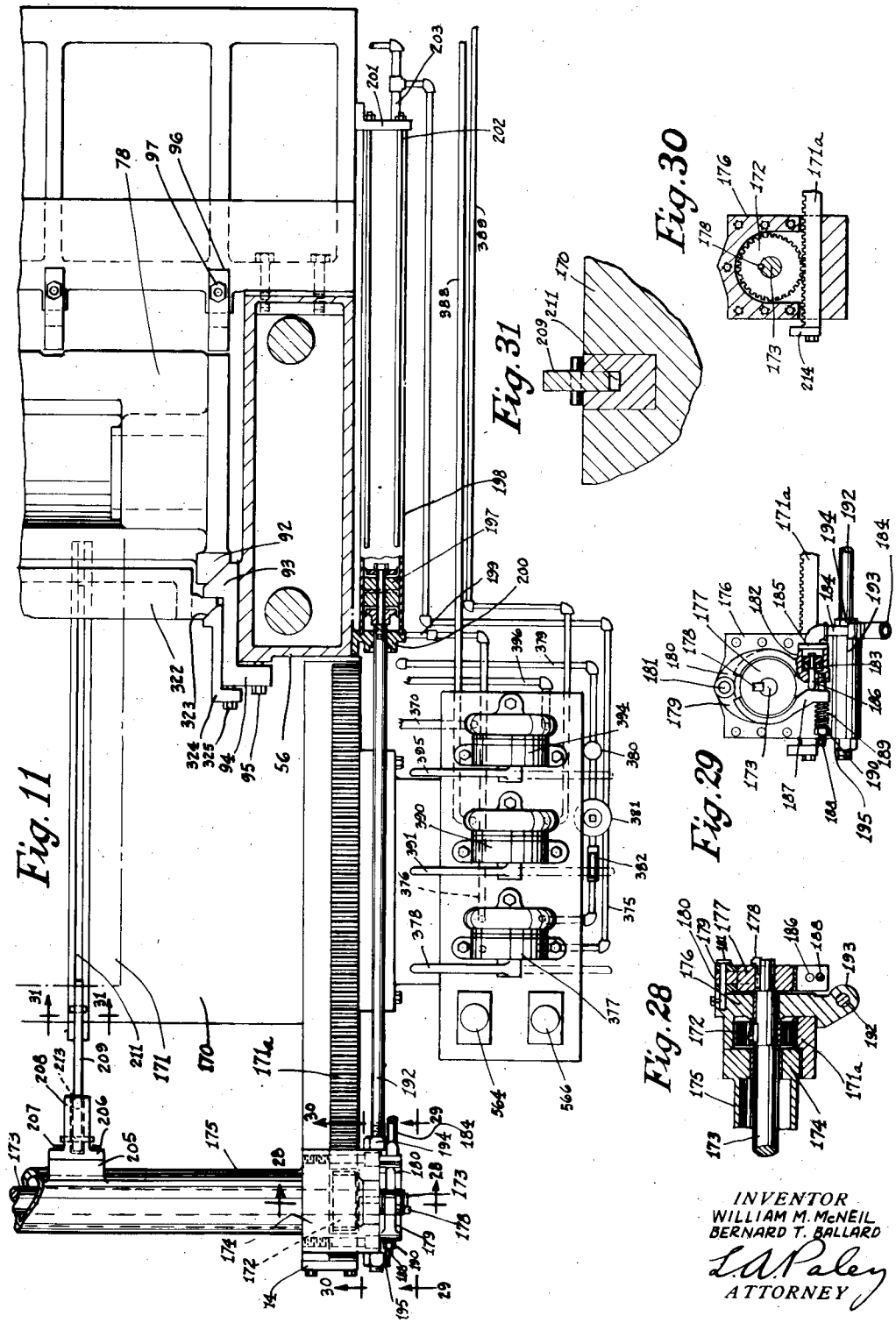


Fig. 11

Fig. 30

Fig. 31

Fig. 29

Fig. 28

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MACHINE FOR PRODUCING EXPANDED METAL

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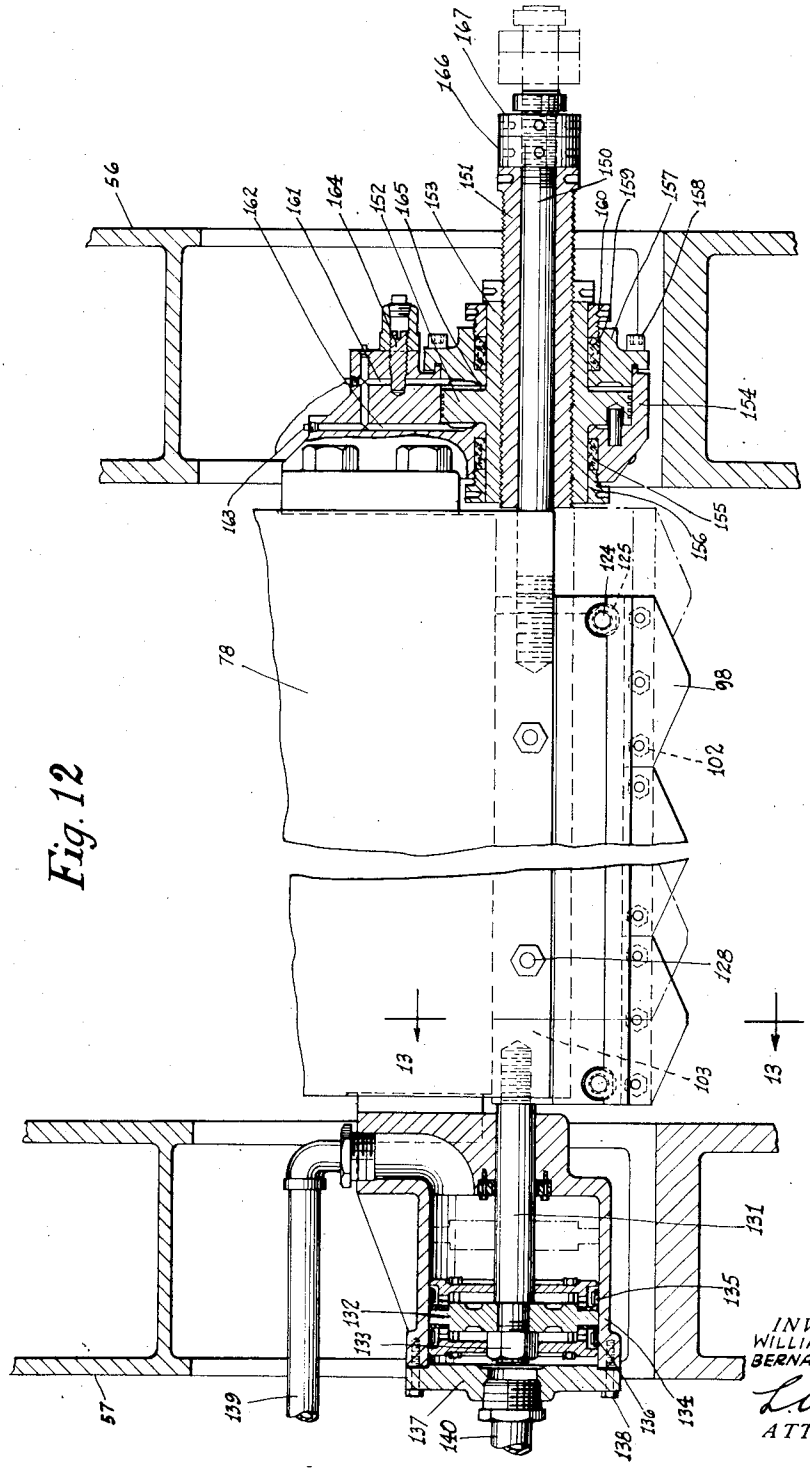


Fig. 12

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MACHINE FOR PRODUCING EXPANDED METAL

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Fig. 18

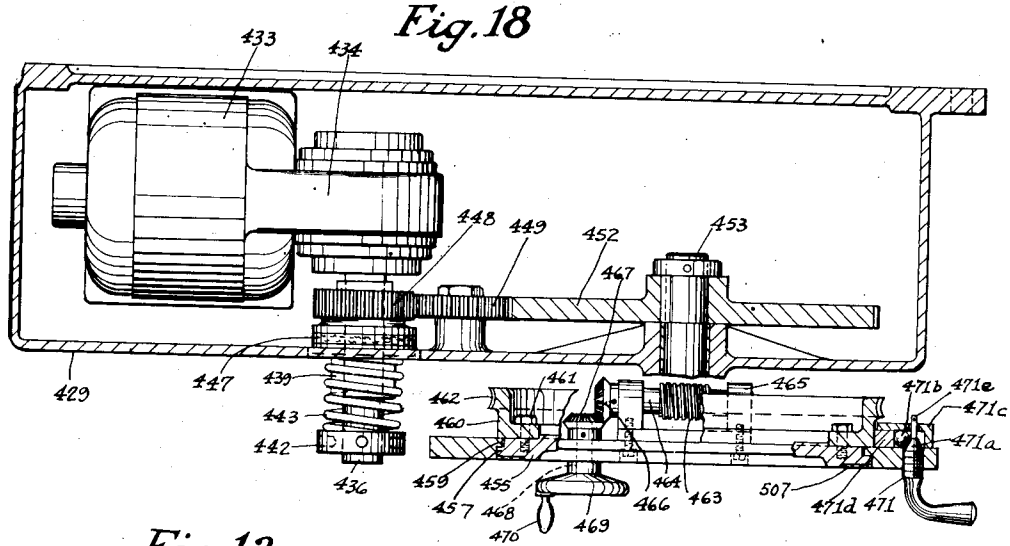
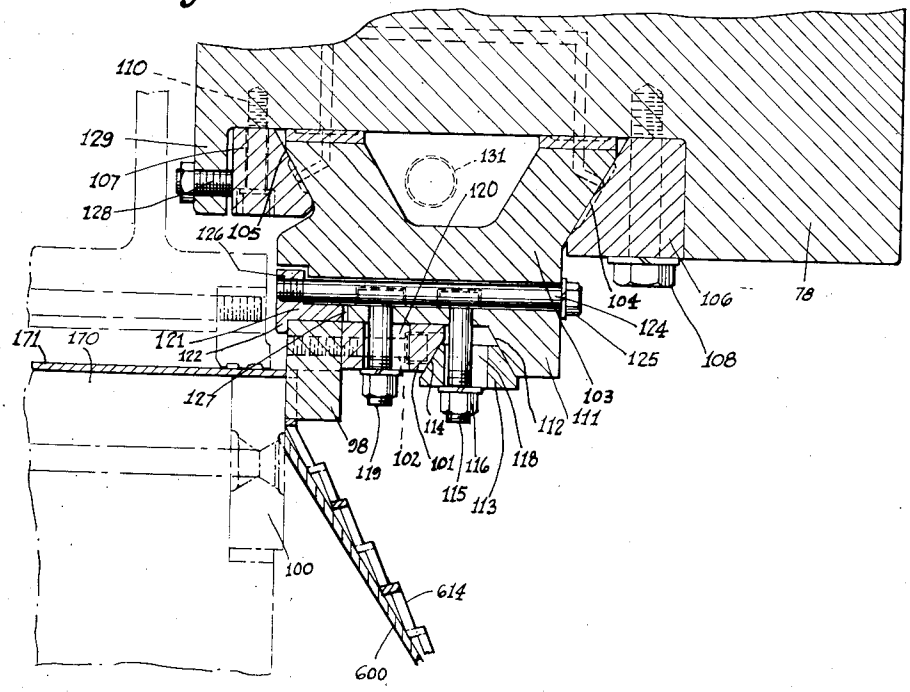


Fig. 13



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MACHINE FOR PRODUCING EXPANDED METAL

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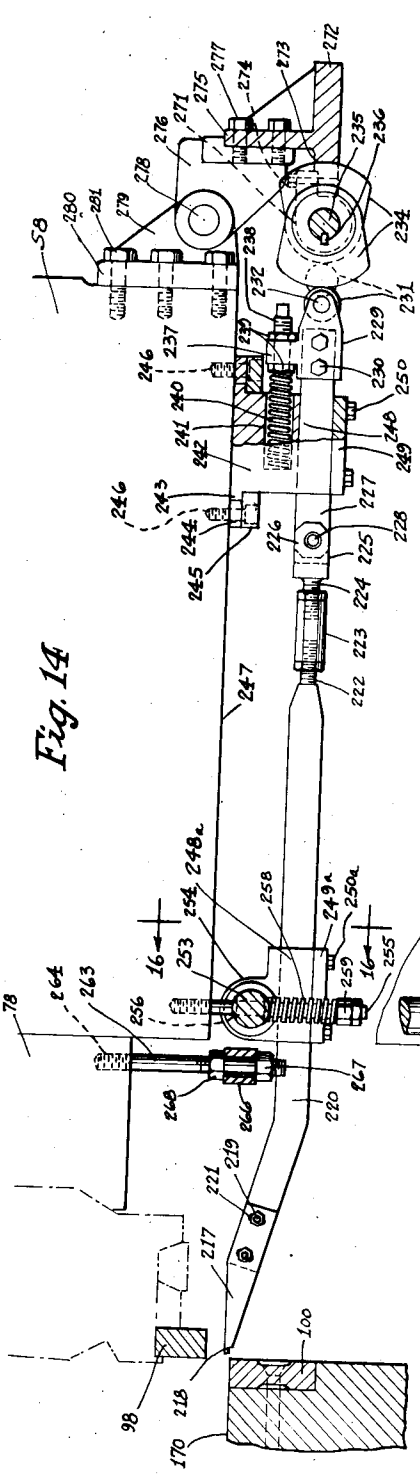


Fig. 14

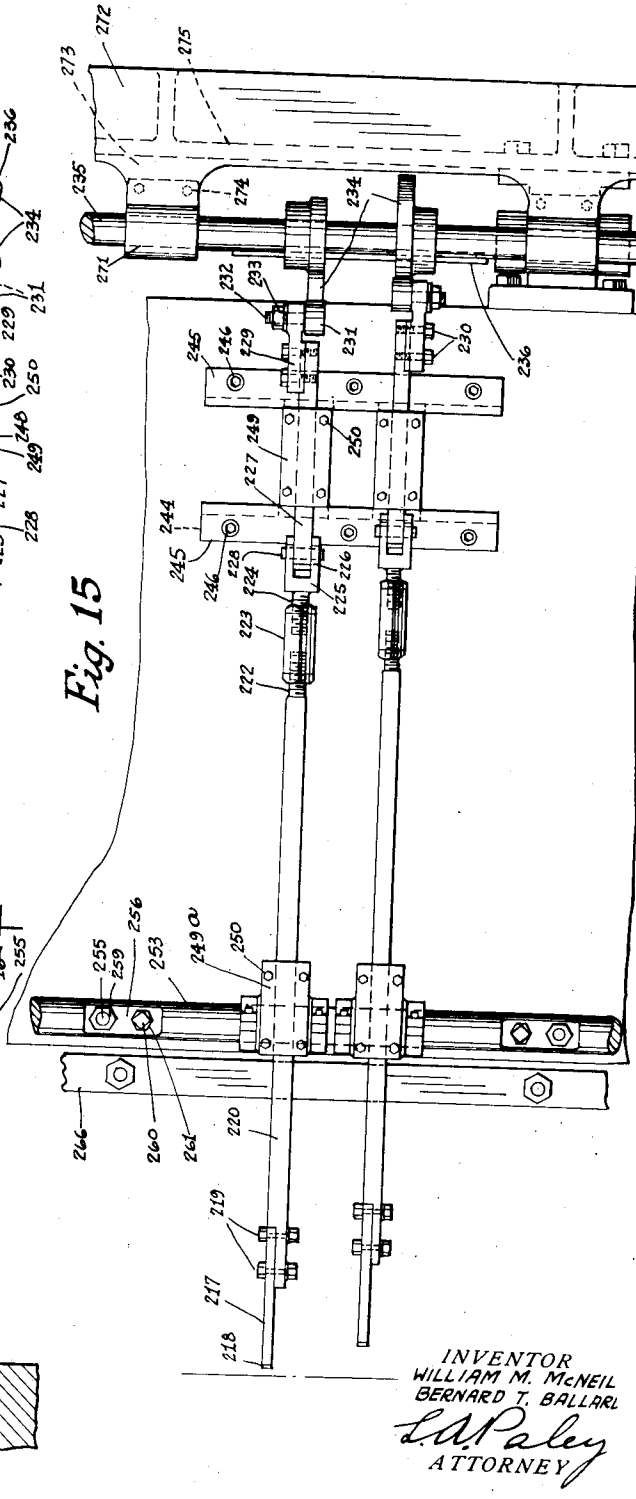


Fig. 15

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MACHINE FOR PRODUCING EXPANDED METAL

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Fig. 24

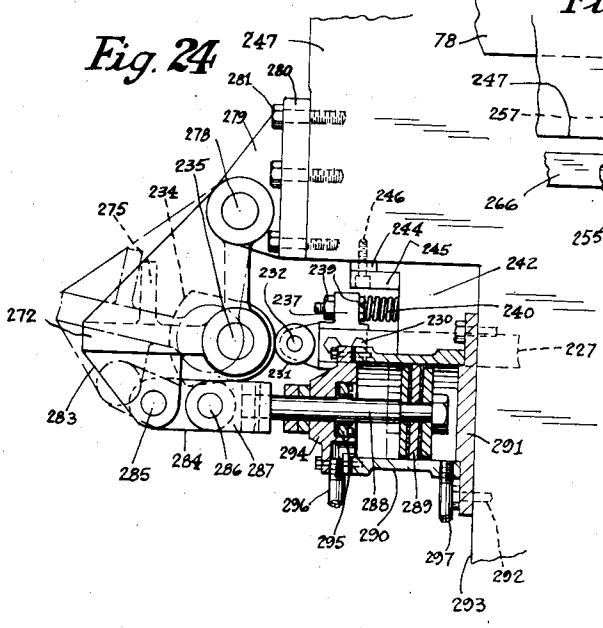


Fig. 16

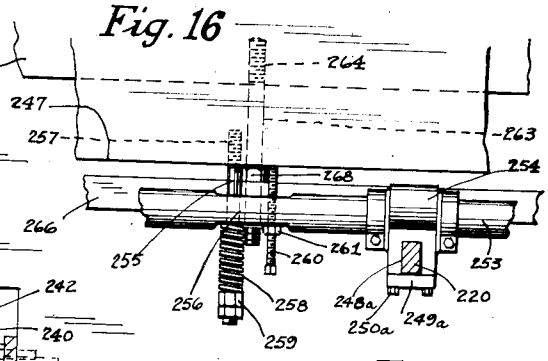


Fig. 27

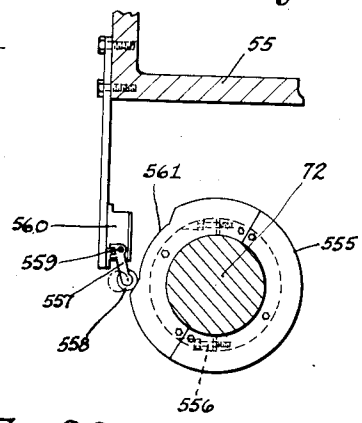


Fig. 25

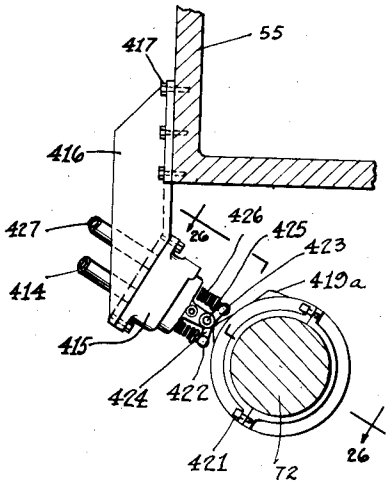
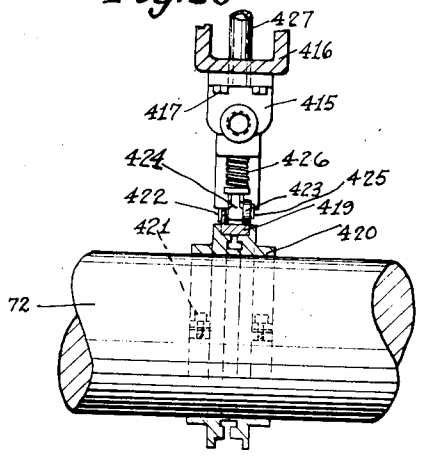


Fig. 26



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MACHINE FOR PRODUCING EXPANDED METAL

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Fig. 17

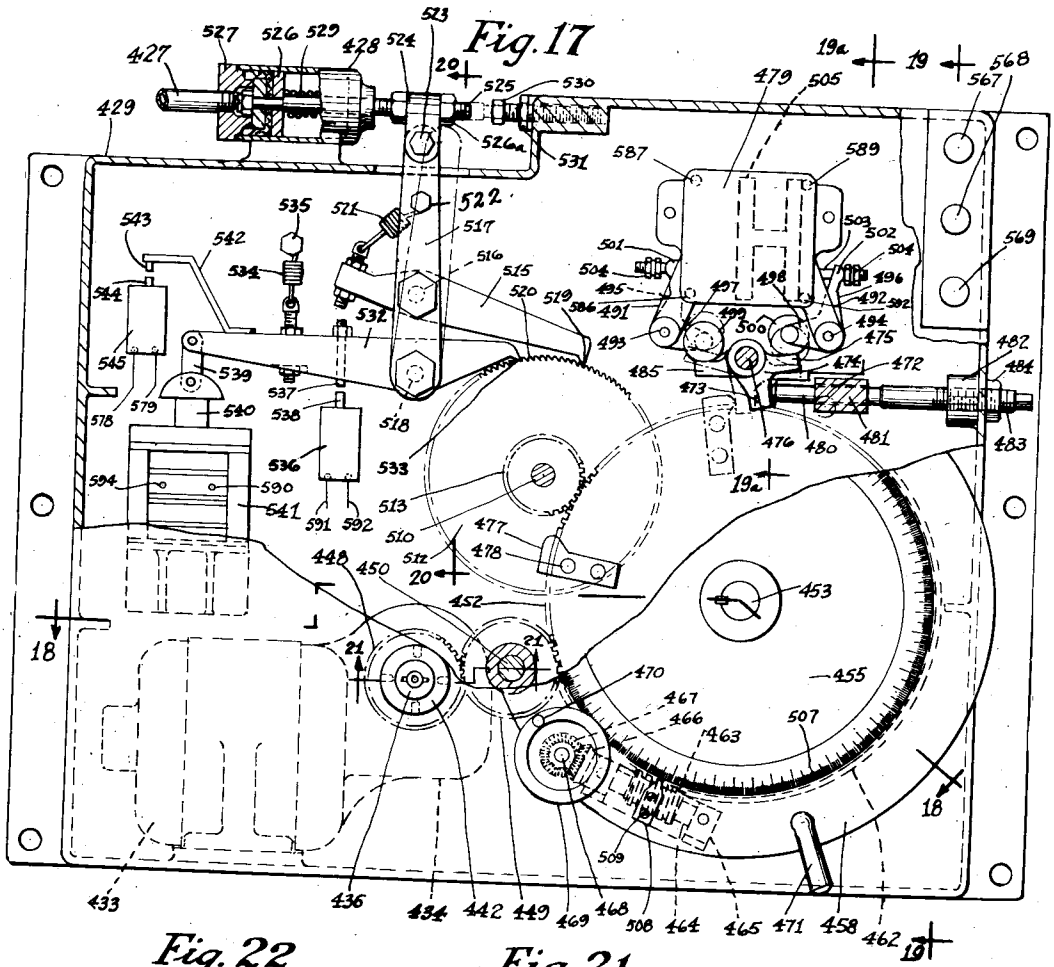


Fig. 22

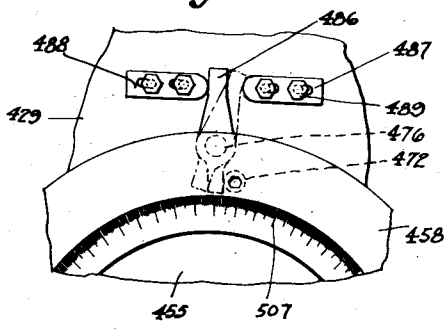
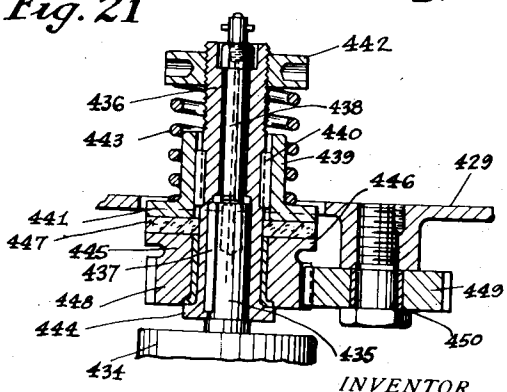


Fig. 21



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MACHINE FOR PRODUCING EXPANDED METAL

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Fig. 19

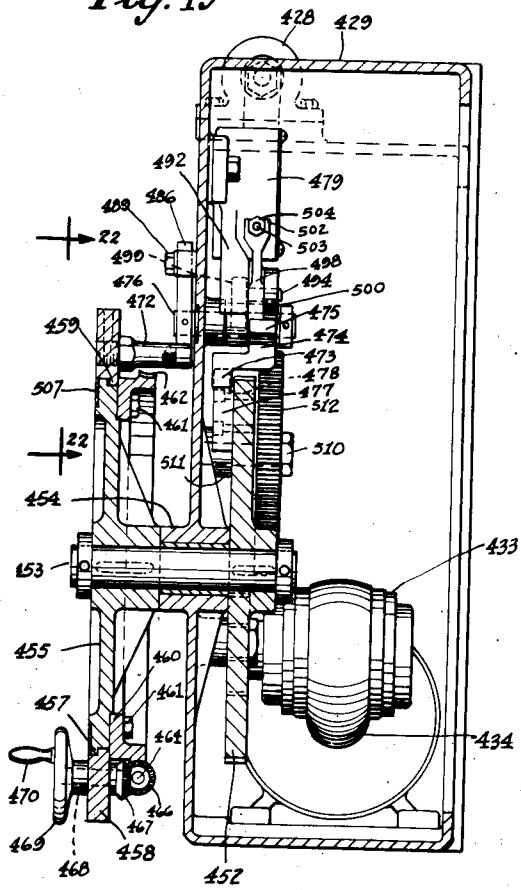


Fig. 19A

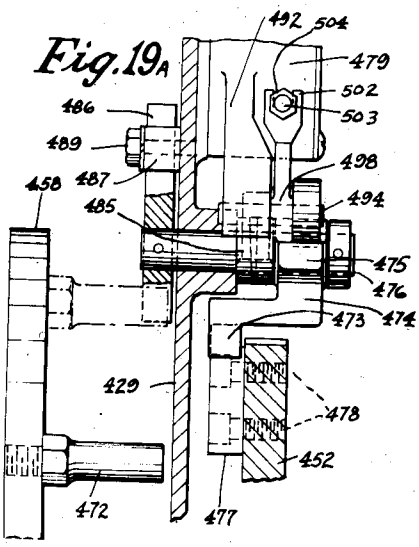


Fig. 20

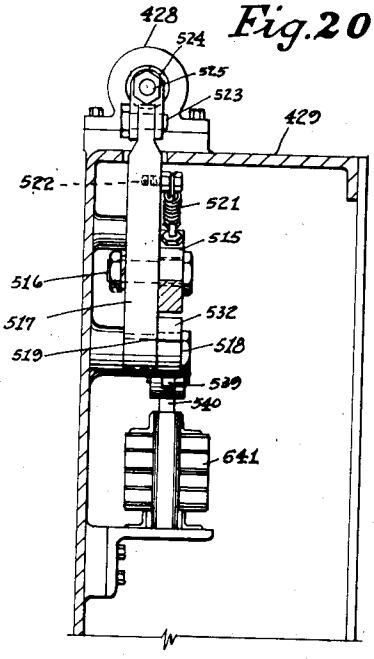
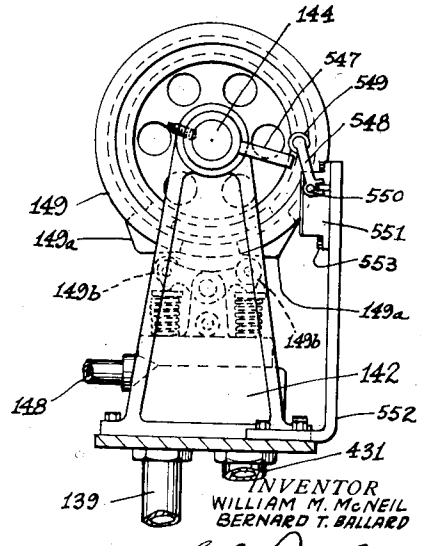


Fig. 23



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June 3, 1941. W. M. McNEIL ET AL 2,244,305

MACHINE FOR PRODUCING EXPANDED METAL

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Fig. 39

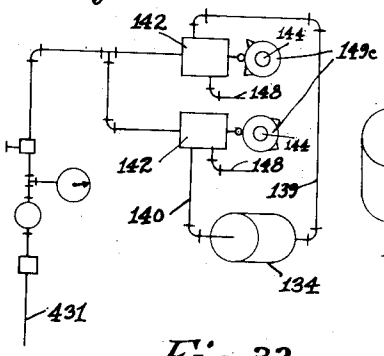
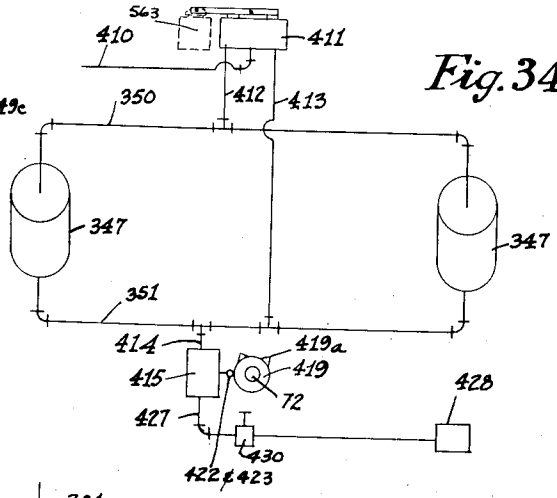


Fig. 33

Fig. 34



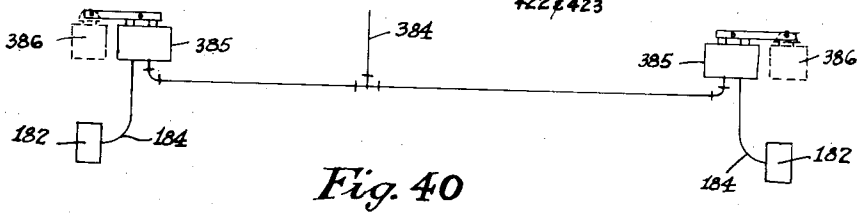
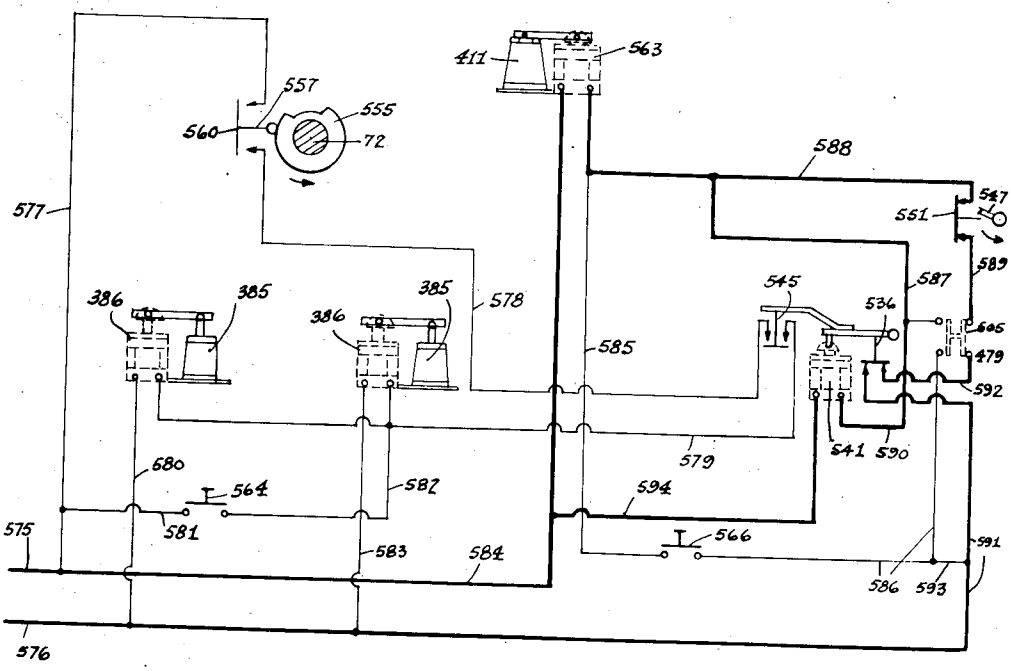


Fig. 40



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MACHINE FOR PRODUCING EXPANDED METAL

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Fig. 35

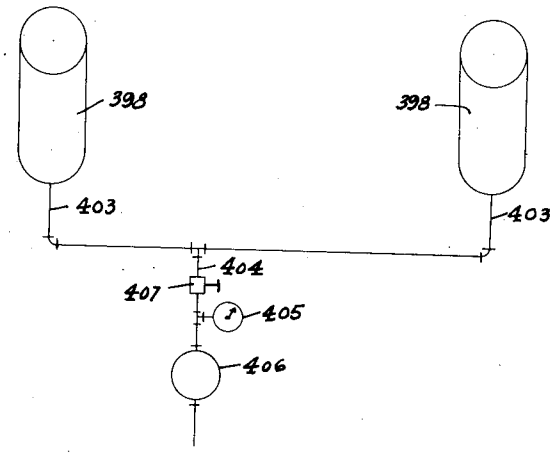


Fig. 36

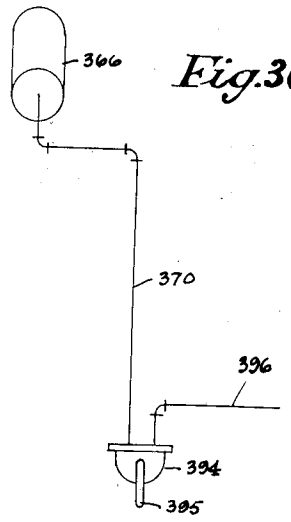


Fig. 37

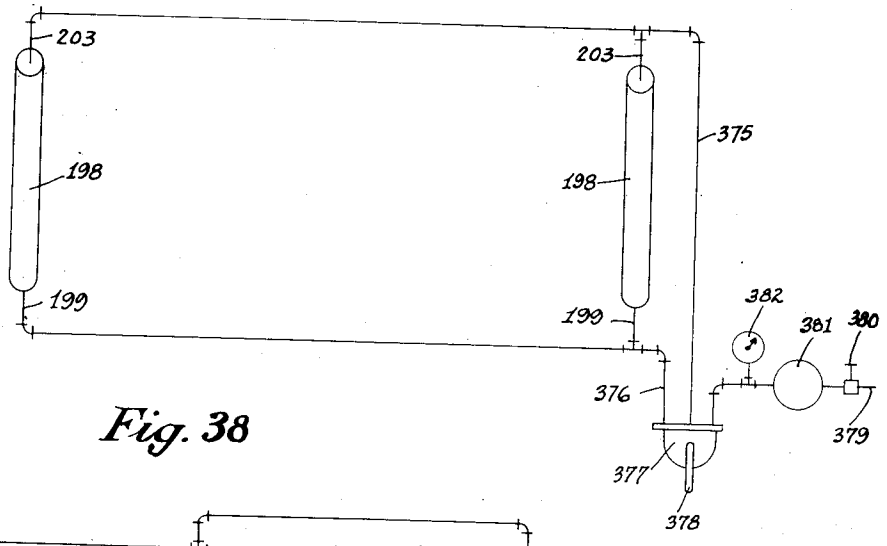
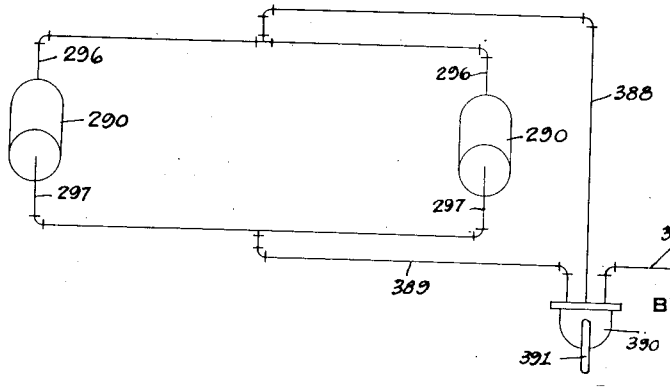


Fig. 38



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MACHINE FOR PRODUCING EXPANDED METAL

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Fig. 41

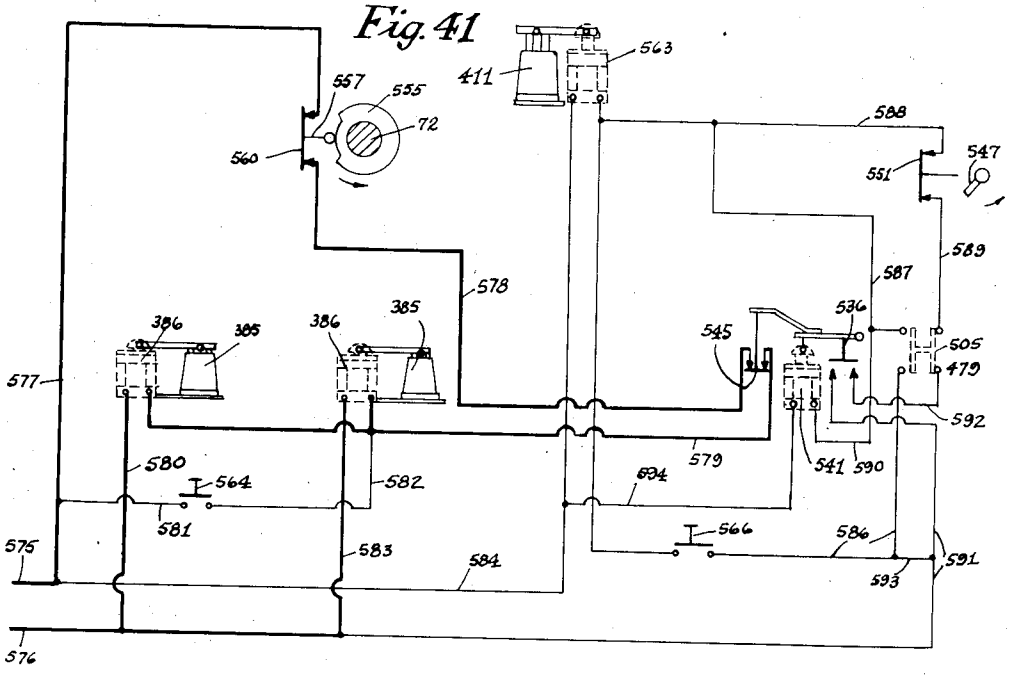
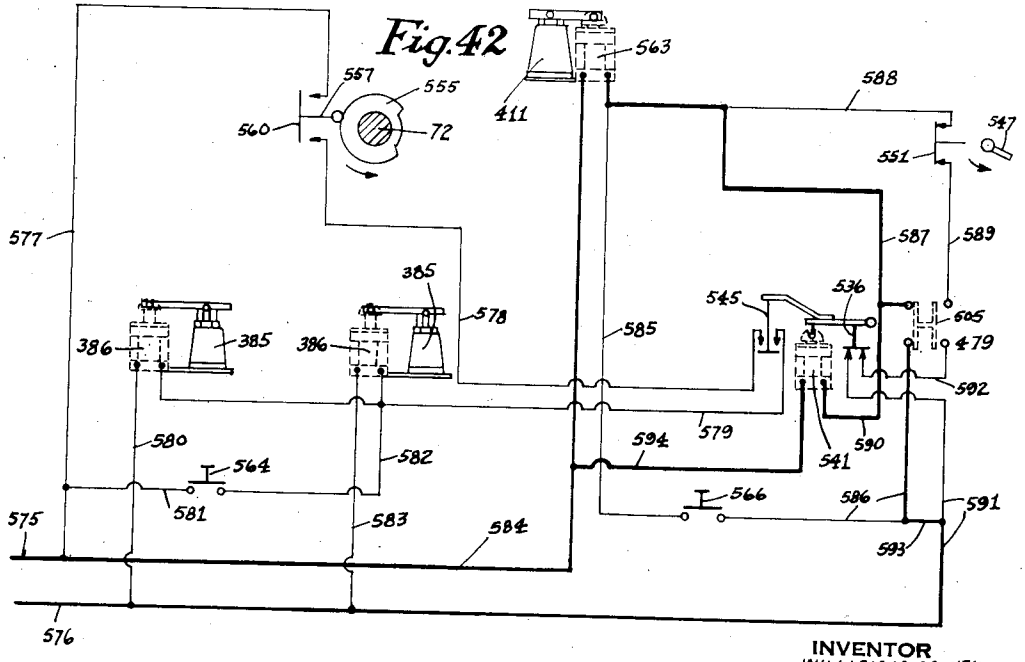


Fig. 42



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MACHINE FOR PRODUCING EXPANDED METAL

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Fig. 43

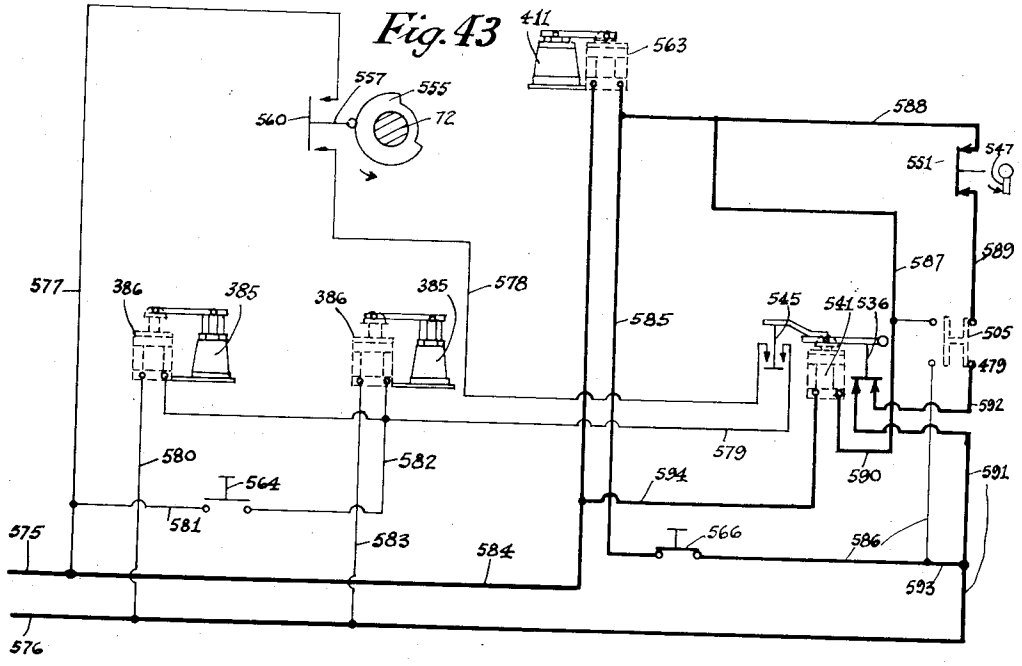
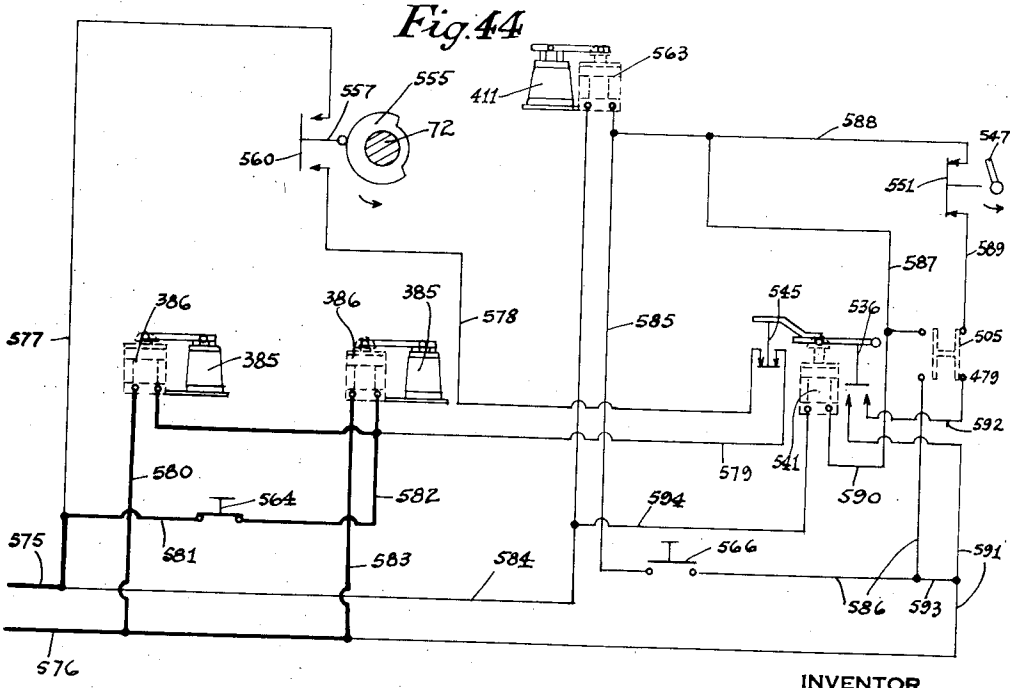


Fig. 44



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ATTORNEY

Patented June 3, 1941 2,244,305

UNITED STATES PATENT OFFICE

2,244,305

MACHINE FOR PRODUCING EXPANDED METAL

William M. McNeil, Wheaton, Ill., and Bernard T. Ballard, Warren, Ohio, assignors to United States Gypsum Company, Chicago, Ill., a corporation of Illinois

Application August 16, 1939, Serial No. 290,531

42 Claims. (Cl. 164—6.5)

This invention relates to machines for producing expanded metal and has reference more particularly to machines of the guillotine type in which sheets of metal are slitted and expanded during the intermittent forward feeding of the machine.

In the making of expanded metal by the type of machine known as the guillotine machine, a series of triangular knives reciprocate vertically and slit and expand half diamonds of expanded metal from the edge of a sheet. It is necessary to either shift the sheet transversely between each stroke or shift the knives transversely at each stroke in order to get half diamonds in staggered relation. Guillotine machines heretofore proposed have been largely mechanically controlled, when necessary to make a variety of sizes and varieties of expanded metal, a great deal of time was consumed in altering the adjustments of the machine to provide for the different varieties of expanded metal.

In order to provide a machine with greater versatility and with less labor being required in shifting from one variety of expanded metal to another, we have provided a machine with controls operated by compressed air and interlocked by an electrical system so that by very minor changes the machine can be rapidly changed to make a different variety of expanded metal.

Furthermore, the machines for making expanded metal were of the class known as double acting or as single acting. With the single acting machine of the type herein disclosed, no provision has previously been made for providing an automatic cutoff so that after a given number of strokes or the formation of a given number of half diamonds, the sheet would be automatically cutoff. It was necessary for an operator to count the number of strokes in order to determine the width of the sheet and then actuate manual means to accomplish the cutoff. This operation of manually controlling the cutoff and counting the number of strokes became especially doubtful when small mesh expanded metal was produced having a relatively large number of diamonds. Frequent mistakes were made and excessive waste was produced by reason of cutting off too late or too soon.

An object of this invention, therefore, is to provide a machine controlled automatically by compressed air and interlocked by an electrical system where manual operation and counting of strokes is entirely eliminated.

Another object of the invention is to provide a machine which can be quickly changed over to produce a different variety or size of expanded metal with a minimum of lost time and labor, thus increasing the usefulness and versatility of the machine.

Another object of the invention is to provide a machine of the type described which feeds the sheet straight into the cutting knives so that no trouble is experienced with commercial sheets whose ends are not square; also to improve expanded metal machines in other respects hereinafter specified and claimed.

Reference is to be had to the accompanying drawings forming a part of this specification, in which:

Fig. 1 is a front elevation of the expanded metal machine

Fig. 2 is a plan view of the machine.

Fig. 3 is a rear elevation of the machine.

Fig. 4 is an elevation showing the left hand side of the machine.

Fig. 5 is an elevation showing the right hand side of the machine.

Fig. 6 is a sectional front elevation with parts broken away to disclose the construction, and taken on line 6—6 of Fig. 5.

Fig. 7 is a sectional elevation through the machine taken on line 7—7 of Fig. 2.

Fig. 8 is a sectional elevation through the machine taken on line 8—8 of Fig. 1.

Fig. 9 is a sectional elevation through the machine taken on line 9—9 of Fig. 1.

Fig. 10 is a sectional detailed elevation on a large scale taken on line 10—10 of Fig. 1.

Fig. 11 is a sectional plan view through the machine taken on line 11—11 of Fig. 5.

Fig. 12 is a sectional elevation on an enlarged scale through the machine taken on line 12—12 of Fig. 5.

Fig. 13 is a sectional elevation through the machine taken on line 13—13 of Fig. 12.

Fig. 14 is a sectional elevation on an enlarged scale through the stop mechanism taken on line 14—14 of Fig. 2.

Fig. 15 is a bottom view of a portion of the stop mechanism.

Fig. 16 is a sectional elevation through the stop mechanism taken on line 16—16 of Fig. 14.

Fig. 17 is a sectional elevation of the control cabinet with parts broken away to disclose the construction.

Fig. 18 is a sectional plan view through the control cabinet taken on line 18—18 of Fig. 17.

Fig. 19 is a sectional elevation through the control cabinet taken on line 19—19 of Fig. 17.

Fig. 19A is a sectional view through the control cabinet taken on line 19A—19A of Fig. 17.

Fig. 20 is a sectional elevation through the control cabinet taken on line 20—20 of Fig. 17.

Fig. 21 is a sectional plan view through a portion of the control cabinet taken on line 21—21 of Fig. 17.

Fig. 22 is a fragmental elevation of a portion of the control dial for the counting mechanism on line 22—22 of Fig. 19.

Fig. 23 is a sectional elevation on an enlarged scale through a switch mechanism taken on line 23—23 of Fig. 6.

Fig. 24 is an elevation on an enlarged scale of a portion of the machine taken on line 24—24 of Fig. 2, with parts broken away to disclose the construction.

Fig. 25 is a sectional elevation on an enlarged scale through the machine taken on line 25—25 of Fig. 1.

Fig. 26 is a sectional elevation on an enlarged scale through a portion of the machine taken on line 26—26 of Fig. 25.

Fig. 27 is a sectional elevation on an enlarged scale through a portion of the machine taken on line 27—27 of Fig. 1.

Fig. 28 is a sectional elevation through a portion of the machine taken on line 28—28 of Fig. 11.

Fig. 29 is an elevation showing a portion of the machine taken on line 29—29 of Fig. 11 with parts broken away to disclose the construction.

Fig. 30 is a sectional elevation through a portion of the machine taken on line 30—30 of Fig. 11.

Fig. 31 is a sectional elevation through a portion of the machine on the line 31—31 of Fig. 11.

Fig. 32 is a sectional elevation through the machine taken on line 32—32 of Fig. 8.

Figs. 33, 34, 35, 36, 37, 38 and 39 are compressed air piping diagrams of the mechanisms controlling the feeding device, hold-down device, counterbalancing cylinders, flywheel brake, feeding cylinders, stop control cylinders, and cutter bar cylinder, respectively.

Figs. 40 to 44, inclusive, are electrical wiring diagrams for the machine at various stages in its operation, active circuits being shown in heavy lines, and inactive circuits by light lines.

In order to more fully describe the invention the various mechanisms will be described by numerals grouped according to function.

Main drive and framing

A driving motor 50 is mounted upon a platform 51 having outstanding arms 52 which are pivotally connected by pin 53 to a fixed bracket 54 secured to the crown member 55 of the machine. Side frames 56 and 57 support the crown member 55, said side members 56 and 57 being in turn supported by a machine bed 58 mounted upon a suitable concrete base 59. For convenience and strength these frame members are preferably of welded steel plate. The motor platform 51 is supported by a pivotally mounted arm 60 connected by turn buckle 61 to an arm 62 which is pivotally mounted on pin 63, said pin 63 being secured in a bracket 64 which is rigidly mounted upon one side of the crown 55.

A V-pulley 65 is secured to motor shaft 66 and is connected by multiple V-belts 67 or other suitable driving means to a massive flywheel and pulley 68 secured to a countershaft 69. A pinion 70 is mounted upon each end of the countershaft 69, each of said pinions 70 meshing with a spur gear 71, said gears being secured on the ends of a main cam shaft 72. A pair of cams 74 are formed on the cam shaft 72 and cam collars 75 engage the cams 74, each of said collars 75 having an outstanding shoulder 76 which is threaded internally to receive an adjusting screw 77. A vertically reciprocating crosshead 78 is pivotally supported on the bottom end of the screw 77 by means of pivot pins 79. A bracket 80 pivotally supports each of the pins 79 and the bottom end of screw 77 is provided with annular shoulder 81 which rotatably engages bracket 80 and is held in place by collar 82 and bolts 83. A beveled gear 84 is secured to the screw 77 above collar 82 and meshes with a beveled pinion 85 which is secured to a stub shaft 86, said shaft 86 being rotatably mounted in a bearing 87 formed on an arm 88 constituting a part of bracket 80. An adjusting wheel 89 is secured to the outer end of shaft 86, said wheel having peripheral holes 90 for the insertion of a bar to accomplish the rotation of said wheel 89 and the vertical adjustment of crosshead 78 relative to cam shaft 72. A locking member 90*a* adjusted by bolt 90*b* serves to lock the screw 77 in adjusted position. Beveled slides 92 are formed on the ends of crosshead 78 and engage beveled slideways 93 formed on the bracket 94 which is secured by bolts 95 to the side frames 56 and 57. Slideways 93 thus guide the crosshead 78 in its vertical reciprocating movement. Wedge shaped members 96 in slideways 93 are adjusted by bolts 97 to regulate the sliding fit of slideways 93.

Slitting and expanding knives and related mechanism

Triangular guillotine slitting and expanding knives 98 are secured to a transversely extending bar 101 by bolts 102, said knives lying in registering relation with a lower knife 100. A knife slide carrier 103 has opposite dovetailed surfaces 104 and 105 which engage slide bars 106 and 107, respectively, to permit longitudinal reciprocation of the carrier 103. The bar 106 is secured to the crosshead 78 by bolts 108 and the bar 107 is secured to the crosshead 78 by bolts 110. An elongated shoulder 111 is formed on the carrier 103 and is provided with an inclined wedge surface 112 to engage one edge of a wedge bar 113. The opposite edge of wedge bar 113 is provided with an inclined surface 114 which engages a similar inclined surface on bar 101. Bolts 115 having nuts 116 are arranged to force the wedge bar 113 upwardly (Fig. 13) so as to increase the distance between bar 101 and shoulder 111, thus bringing the knives 98 closer to the lower knife 100. Each of the bolts 115 passes through a slot 118 in the bar 113 so as to permit lateral movement of said bar 113. Lock bolts 119 pass through slots 120 in the bar 101 and serve to lock the bar 101 against the lower face of the carrier 103. An elongated bar 121 has a downstanding shoulder 122 which engages the left hand side of knife bar 98 and a tap bolt 124 having a head 125 engages an upstanding shoulder 126 on bar 121 so as to force the bar 101 to the right to give greater clearance between the knives 98 and the lower knife 100. Clearance 127 is provided between the shoulder 126 and the carrier 103 to permit adjustment of the clearance between knives 98 and 100. A set bolt 128 is provided with a downstanding shoulder 129 formed on the crosshead 78 so as to force the bar 107 slightly inwardly to provide the correct sliding clearance

between the carrier 103 and slide bars 106 and 107.

A piston rod 131 (Fig. 12) is screwed into the left hand end of the carrier 103 and a piston 132 is secured on the opposite end of piston rod 131 by a nut 133. A cylinder 134 surrounds the piston 132 and said piston is provided with packing rings 135 and 136 so that the piston 132 is double acting in the cylinder 134. A cylinder head 137 closes the open end of cylinder 134, being secured thereto by bolts 138. A compressed air inlet pipe 139 leads into the right hand end of cylinder 134 and a compressed air pipe 140 is connected to the cylinder head 137. Pipes 139 and 140 lead to two three-way valves 142 and a compressed air supply pipe 143 also leads to the valves 142. A shaft 144 is associated with the valves 142 and a sprocket wheel 145 is mounted on the shaft 144, being connected by a chain 146 to a sprocket pinion 147 secured to the shaft 72. An exhaust pipe 148 is provided on each valve 142 so as to intermittently exhaust the air from the cylinder 134 as the piston 132 reciprocates axially. Cams 149 are secured to the shaft 144, each of said cams having a pair of cam points 149a which engage a pair of rollers 149b to open each valve 142 momentarily as the shaft 144 rotates, thus actuating the piston 132 and reciprocating the knives 98.

A piston rod 150 is screwed into the opposite end of carrier 103 (Fig. 12) and said rod passes through a sleeve 151 which is threaded externally to engage the inside of the piston 152 having annular outstanding shoulders 153 which are threaded internally to engage the sleeve 151. A cylinder 154 is formed about the piston 152, being provided with a packing ring 155 and a gland 156. A cylinder head 157 is secured to the cylinder 154 by bolts 158 and said head is provided with a packing ring 159 and gland 160. The purpose of the piston 152 and cylinder 154 is to form a hydraulic dash pot for cushioning the starting and stopping of the carrier 103 at each end of the stroke. The top of cylinder 154 is provided with internal oil grooves 161 and 162 which are filled with oil by removing screw plugs 163. An adjusting screw 164 extends into the oil groove 161 to regulate the flow of oil from one side of the piston 162 to the other side. A clearance 165 of about ¼" is provided in the cylinder 154 for the movement of the piston 152. The piston rod 150 is slidable axially in the sleeve 151 and is threaded externally at the right hand end to receive an adjusting collar 166 and lock collar 167. The collar 166 strikes against the end of the sleeve 151 when the carrier 103 moves to its extreme left hand position so as to force the piston 152 to the left against the oil pressure. When the carrier 103 moves to its extreme right hand position, the end thereof strikes against the left hand end of sleeve 151 and forces the piston 152 to the right against the pressure of oil, the oil passing through oil passages 161 and 162 from one side of the piston to the other with a restricted flow due to the adjusting screw 164. The action of the mechanism described is to cause the knives 98 to move transversely, after returning vertically from a slitting and expanding stroke, the distance of one-half a diamond, so that, when the knives again move vertically for a slitting and stretching operation, the new half diamonds produced are in staggered relation to those produced in the preceding motion of downward extending knives 98.

Sheet feeding mechanism

A table 170 is provided on the front end of the machine for receiving sheets of metal 171 to be slitted and expanded to form expanded metal. A rack 171a is mounted at each end of the table 170 and a spur pinion 172 engages each rack 171a, said pinions 172 being secured near each end of a feed shaft 173. Each end of the shaft 173 is rotatably mounted in bearing heads 174 formed at each end of the feed tube 175. A bracket 176 is secured to each of the heads 174, said bracket 176 being slidably associated with the rack 171a and serving as a bearing for the outer ends of shaft 173. A brake disk 177 is secured to each extreme outer end of shaft 173 by keys 178. Brake shoes 179 and 180 are hingedly connected at one end to the bracket 176 by hinge pin 181. The opposite end of brake shoe 180 is provided with a compressed air cylinder 182 and a piston 183 is mounted in the cylinder 182. Compressed air is let into the cylinder 182 through a pipe 184 connected to a cylinder head 185. A piston rod 186 leads from the piston 183 through the end of brake shoe 180 and bears against the free end 187 of brake shoe 179. A stud 188 extends slidably through the brake shoe end 187 and is threaded onto the end of brake shoe 180. A compression spring 189 is confined between the brake shoe end 187 and a nut 190 threaded onto the end of stud 188 so as to normally urge the brake shoes 179 and 180 together and lock the rotating movement of feed shaft 173.

In order to move the feed device along the racks 171a, we provide a piston rod 192 which passes through an annular shoulder 193 formed on the bracket 176, being secured thereto by nuts 194 and 195. The opposite ends of piston rod 192 are connected to a double acting piston 197 which operates slidably in a feed cylinder 198. A compressed air pipe 199 leads into a cylinder head 200 formed on one end of cylinder 198. The cylinder head 201 is provided on the opposite end of cylinder 198, the heads 200 and 201 being connected by tie rods 202. A compressed air pipe 203 leads through the cylinder head 201 so that when the compressed air is admitted through pipe 199 the feed mechanism tends to move to the right (Fig. 11) to cause the sheet of metal 171 to be fed toward the knives 98. When the sheet of metal is stretched and expanded to form expanded metal, air is admitted through a pipe 203 to the cylinder 198 to return the feed mechanism for the insertion of a new sheet of metal.

A plurality of shoulders 205 are secured on the tube 175. A bifurcated bracket 206 is secured to each shoulder 205 by bolts 207, each bracket 206 being provided with spaced arms 208. An arm 209 is pivoted at one end between the arms 208 by pivot pin 210. The opposite end of each arm 209 extends into a groove 211 formed longitudinally in the table 170, each arm 209 having a notch 212 at its inner end to engage the rear edge of the sheet of metal 171. A compression spring 213 extends between the bracket 206 and each arm 209 to force said arm 209 downwardly into the groove 211. A stop 214 is secured to the end of each rack 171a to limit the rearward movement of the feed mechanism.

Strand width gauging device

As the sheet of metal 171 is advanced by the feeding mechanism hereinbefore described, the edge of said sheet is gauged by a series of gaug-

ing fingers 217, each of which is provided with a notch 218 to engage said sheet. Each of the fingers 217 is connected by bolts 219 to a gauge bar 220, said gauge finger having slots 221 to permit slight adjustment of said fingers 217 relative to the bar 220. The opposite end of bar 220 is provided with a threaded stud 222 which is engaged by a turn buckle 223 and said turn buckle engages a threaded stud 224 formed on the end of the bifurcated bracket 225 having spaced lugs 226. A cam bar 227 engages between the lugs 226 and is pivoted thereto by a pivot pin 228. A bracket 229 is secured to the end of each bar 227 by bolts 230, the opposite end of said bracket 229 being provided with a roller 231. A stud 232 held in place by nut 233 on the end of bracket 229 rotatably supports the roller 231 in contact with the surface of a cam 234 which is secured to a cam shaft 235 by a key 236. An upstanding shoulder 237 is formed on the bracket 229 and a stud 238 is secured in the shoulder 237 by lock nuts 239. A compression spring 240 engages the end of stud 238 and is seated in a recess 241 formed in a slide bracket 242. The bracket 242 is provided with opposite outstanding lugs 243 which are clamped in place by bars 244 and 245, said bars being secured by bolts 246 to the bottom 247 of the machine frame. The bottom of bracket 241 is bifurcated to form a slideway 248 having cover plate 249 secured thereto by bolts 250 so as to permit the free endwise reciprocation of bar 227 under the action of cam 234 and spring 240.

The bar 220 is provided with a slide bracket support 248*a* having a cover plate 249*a* secured to said bracket by bolts 250*a*. The bar 220 is thus supported by bracket 248*a* for sliding movement in said bracket. A rod 253 passes through an upstanding shoulder 254 formed on the bracket 248*a* and a stud 255 passes through a flat section 256 formed on the rod 253, said stud having a threaded section 257 which is threaded into the machine bottom 247. A compression spring 258 is supported on a stud 255 and is confined between a nut 259 on said stud 255 and the flat section 256 so as to normally urge the bar 220 upwardly about pivot pin 228. An adjusting bolt 260 also passes through the flat section 256 and engages the machine bottom 247 to limit the upward movement of the bar 220, said stud 260 being provided with a lock nut 261. A stud 263 has a threaded section 264 threaded into the bottom of a crosshead 78 and the bottom end of said stud rigidly engages a transverse bar 266, being secured thereto by nuts 267 and 268. As crosshead 78 is lowered, the bar 266 engages the top of bars 220 so as to move said bars 220 and fingers 217 downwardly about pivot pin 228.

The shaft 235 is rotatably mounted in a plurality of bearings 271 which are secured to a T-shaped frame member 272 having outstanding shoulders 273 by bolts 274. The frame member 272 has an upstanding elongated flange 275 and bifurcated brackets 276 are secured to the flange 275 by bolts 277. The brackets 276 are each pivotally connected by a stud shaft 278 to an outstanding flange 279 formed on a bracket 280, said bracket being secured to the machine 247 by bolts 281.

Downstanding flanges 283 are formed on the frame 272 and a link 284 is pivotally connected at one end by pin 285 to the shoulders 283. The opposite end of the link 284 is pivotally connected by a pin 286 to a bifurcated bracket 287 which is secured to the end of a piston rod 288. The opposite end of rod 288 is provided with a piston 289 which operates in a cylinder 290. The cylinder 290 is provided at one end with a cylinder head 291 secured by bolts 292 to machine frame 293. The opposite end of cylinder 290 is provided with a cylinder head 294 which slidably supports the piston rod 288 and is provided with suitable packing 295 around the piston rod 288. A pipe 296 enters the cylinder 290 through cylinder head 294 and a pipe 297 enters the cylinder 290 adjacent the cylinder head 291. When compressed air is alternately admitted to the cylinder 290 through pipes 296 and 297, the piston 289 and rod 288 are reciprocated axially. When the piston 289 moves to its extreme left hand position (Fig. 24) the bracket 276 is moved about its pivot 278 so that cams 234 are elevated free of the rollers 231, thus permitting the free rotation of cams 234 without reciprocating the bars 227.

One end of the cam shaft 235 is provided with a spur gear 299 which meshes with a spur gear 300 secured to the end of a countershaft 301 which is rotatably supported in a bearing 302 formed on a bracket 303, said bracket being secured by bolts 304 to the machine 247. A beveled gear 305 is also secured to the shaft 301 and meshes with a beveled pinion 306 which is secured to the end of a shaft 307. A bracket 308 is secured by bolts 309 to the machine 247 and is provided with a bearing 310 which rotatably supports the lower end of the shaft 307. The upper end of shaft 307 is rotatably supported in a stationary housing 312 and a beveled pinion 313 secured to the upper end of shaft 307 meshes with a beveled pinion 314 which is secured to a countershaft 315, also rotatably supported in the housing 312. A spur gear 316 is secured to the shaft 315 and meshes with the spur pinion 317 which is secured to a countershaft 318, said shaft 318 being rotatably supported by the housing 312. A spur gear 319 is secured to the shaft 318 and meshes with gear 71 so as to accomplish the continuous rotation of the cam shaft 235 when the motor 50 is rotating. Cams 234 are mounted in pairs on shaft 235 opposed 180°, each cam having a dwell out period of 180°. The shaft 235 is rotated at ½ speed of main shaft 72, with the result that alternate sets of fingers 217 are moved in toward knife 100 at each stroke. Provision is made for sliding spur pinion 317 out of mesh with spur gear 316, for the purpose of timing the action of cam shaft 235 in its proper angular relationship with main shaft 72.

Hold-down device

As the sheet of metal 171 is fed forwardly by the feeding mechanism previously described, to be operated on by the knives 98, it is necessary that the sheet 171 be pressed firmly against the table 170 by a hold-down bar 321 at the time the sheet is cut. The hold-down bar 321 is secured to the bottom flange of a beam 322, said beam having inclined slide surfaces 323 at each end to be engaged by a slideway bracket 324 which is secured to the bracket 94 by bolts 325 so that the beam 322 can reciprocate vertically. The beam 322 is supported by a pair of studs 326 which are arranged to reciprocate axially in bearings 327 formed on the beam 322. A compression spring 328 is mounted on each stud 326 between the bearing 327 and a screw collar 329 held in place by a lock collar 330. A screw

collar 331 is threaded onto the lower end of each stud 326, being held in place by a lock collar 332 so as to limit the upward movement of the studs 326 under the action of springs 328.

A pivoted knuckle 335 is screwed onto the upper end of each stud 326 and said knuckle is pivotally secured by pin 336 to a lever bracket 337, said bracket being pivotally mounted at one end by a pin 338 to a stationary part of the frame of the machine. The lever 337 is substantially U-shaped in cross section and has upstanding legs 339 between which is rotatably mounted a roller 340 supported by a pin 341. The roller 340 normally contacts the periphery of a cam 342 which is secured to shaft 72. A piston rod 344 is secured to one end of the lever 337 by nuts 345, and the upper end of piston rod 344 is provided with a double acting piston 346 which is slidably mounted in a cylinder 347 having heads 348 and 349. Compressed air pipes 350 and 351 are connected to the cylinder heads 348 and 349, respectively, so as to alternately supply compressed air to opposite ends of cylinder 347, thus causing the reciprocation of piston 346. The compressed air introduced into the pipes 350 and 351 may be controlled either manually or automatically by devices to be hereinafter described so that the lever 337 and roller 340 are pressed downwardly out of contact with cam 342, thus holding the sheet 171 firmly during two strokes of the knives 98 so as to accomplish the cutting off of a sheet of expanded metal of a desired width. The subsequent lifting of the hold-down bar 321 by the piston 346 will permit the scrapped strip of unexpanded metal to be ejected from the machine by the feeding mechanism.

After the scrap metal is ejected from the machine, current to the motor 50 may be shut off and the operation of the machine stopped by means of a brake shoe 354 operating upon a braking surface 355 on pulley flywheel 68. The brake shoe 354 is pivotally connected by pin 355a to a lever 356. One cam of lever 356 is pivotally connected by pin 357 to a bracket 358 secured to crown member 55 by bolts 359. A second arm of lever 356 is pivotally connected by pin 360 to one end of a link 361. The opposite end of link 361 is pivotally connected by pin 362 to a knuckle bracket 363 secured to the end of a piston rod 364. A single acting piston 365 is secured to the end of piston rod 364 and is slidably received in a cylinder 366 having heads 367 and 368. A compression spring 369 around piston rod 364 inside the cylinder 366 returns the piston 365 after a stroke caused by compressed air admitted through pipe 370 which is connected to cylinder head 368, thus releasing the brake 354 from the flywheel braking surface 355.

Compressed air control system

One of the salient features of our invention lies in the electrical and compressed air control system for insuring the automatic operation of the expanded metal machine, or its manual operation when so desired. The steps in forming the sheet of expanded metal are as follows:

1. The sheet of metal to be expanded is operated upon by knives 98 under manual control to cut off a narrow strip of waste metal to true up the advancing edge of the sheet of metal.

2. The feeding of the metal sheet into the knives is resumed at a predetermined transverse position of the knives 98 so as to insure that the first cut will produce closed diamonds at the corners of the sheet.

3. The slitting and expanding of the sheet is continued automatically until a predetermined number of diamonds is formed, counting of strokes being automatic.

4. The hold-down bar 321 is then pressed downwardly automatically for an extra stroke of knives 98, thus causing the sheet of expanded metal of desired width to be cut from the unexpanded sheet.

5. Continued slitting and expanding is automatically resumed until another sheet of expanded metal is produced and cut off.

6. The strip of scrap metal remaining is then ejected from the machine under manual control and the feeding device is returned for operation upon a new sheet of metal.

The compressed air diagrams of the devices which operate the various functions of the machine are shown in Figs. 33 to 39, inclusive, and will first be described in detail. The electrical switches and circuits for controlling the action of the various compressed air pistons will then be described.

In Fig. 37 we illustrate the air system for controlling the operation of feed pistons 197. It will be noted that the pipes 199 and 203 are connected in parallel, being connected by pipes 375 and 376, respectively, to a valve 377 controlled by a manually actuated handle 378. An air supply pipe 379 leads to the valve 377, said pipe 379 being provided with a hand valve 380, a pressure reducing valve 381, and a pressure gauge 382. By moving the valve handle 378 in one position and operating the feed brakes to be described, the pistons 197 move forwardly of the machine to advance sheet of metal 171 toward the cutting knives 98. When valve handle 378 is moved to the opposite direction, pistons 197 move rearwardly for the insertion of a new sheet of metal into the machine.

In Fig. 33 we illustrate the air system for controlling the operation of the feed brake pistons 183. The pipes 184 leading to cylinders 182 are joined to an air supply pipe 384. A valve 385 is provided on each pipe 184, each of said valves 385 being controlled by electrical solenoids 386 when it is desired to permit the forward feeding of the sheet 171.

In Fig. 38 is illustrated the air system for controlling the operation of the cam disengaging pistons 289. Cylinders 290 are connected together in parallel by pipes 296 and 297. Air pipes 388 and 389 connect the pipes 296 and 297, respectively, to a valve 390 manually controlled by handle 391. An air supply pipe 392 also leads to the valve 390 to supply air to the pipes 388 and 389.

Pipe 370 leading to brake cylinder 366 leads to a valve 394 having a manual control handle 395 (Fig. 36). An air supply pipe 396 leads to the valve 394.

A pair of counterbalance cylinders 398 (Fig. 9) are secured to the crown member 55, said cylinders being provided with pistons 399 having a piston rod 400 pivotally connected by pin 401 to brackets 402 secured to the crosshead 78. An air supply pipe 403 leads to each cylinder and an air pipe 404 leads to the pipes 403. Pipe 404 is provided with a gauge 405, pressure reducing valve 406, and a check valve 407. The cylinders 398 are open to the atmosphere at vent 408 and are always under pressure. This air pressure in cylinders 398 acts as a cushion and the

pressure increases as the pistons 399 descend so that said air pressure acts to aid in lifting the crosshead 78 after each cut of the knives 98.

In Fig. 34 is illustrated the system for controlling the operation of hold-down cylinders 347. An air supply pipe 410 leads to a solenoid valve 411. Air pipes 350 and 351 connect the cylinders 347 in parallel. Air pipe 412 connects pipes 350 with valve 411 and a pipe 413 connects the pipes 351 to the valve 411. A pipe 414 connects the pipes 351 to a poppet valve 415 mounted on a bracket 416 (Figs. 25 and 26) which is secured by bolts 417 to the crown member 55. A double acting cam 419 is mounted for annular adjustment in a collar 420 which is secured by bolts 421 to shaft 72. Cam points 419*a* act on a pair of rollers 422 and 423 which are rotatably mounted on a valve lever 424 which is rotatably mounted on a fixed pin 425. Springs 426 act to resiliently limit the movement of lever 424. The action of the cam 419 is to momentarily introduce compressed air into a pipe 427 which leads to a cylinder 428 mounted above a timing control box 429. Needle valve 430 is provided on the pipe 427 to control the amount of air flowing to cylinder 428. The operation of the compressed air system for the hold-down device as shown in Fig. 34 will be more fully discussed in connection with the description of the electrical circuits.

In Fig. 39 we illustrate diagrammatically the compressed air system for operating the knife reciprocating cylinder 134. An air supply pipe 431 branches and leads to air valves 142 which are operated by cams 149*c*. Pipes 139 and 140 lead to each end of the cylinder so as to accomplish the reciprocation of piston 132 and knives 98.

Electrical control system

Mounted within the counting control box 429 (Fig. 17) is an electric motor 433 provided with a speed reducer 434. A shaft 435 extends outwardly from the reducer 434 and a sleeve 436 is secured to said shaft 435 by a key 437. An extension shaft 438 is screwed into the end of shaft 435, sleeve 436 also extending about said shaft 438. A collar 439 is slidably secured by feather key 440 to the outside of sleeve 436, said collar having an outstanding annular flange 441. A collar 442 is screwed onto the end of sleeve 436 and a compression spring 443 is confined between the flange 441 and a collar 442. The opposite end of sleeve 436 is provided with an annular flange 444 and a friction clutch collar 445 is rotatably mounted on sleeve 436 against limiting flange 444. An annular flange 446 is formed on the collar 445 and a friction clutch disc 447 of friction material, such as hard fiber, is positioned between flanges 441 and 446. A spur pinion 448 is formed on the collar 445 and meshes with a spur pinion 449 which is rotatably mounted on a countershaft 450, said shaft being secured to the box 429.

The pinion 449 meshes with a spur gear 452 which is secured to a shaft 453, said shaft being rotatably mounted in a bearing 454 formed on the box 429. A counting dial 455 is also secured to the shaft 453 outside of the box 429. An annular flange 457 is formed around the periphery of dial 455 and an annular ring disc 458 is rotatably fitted to the outside of dial 455, said disc being provided with an inwardly extending annular flange 459 which rotates against the flange 457. An annular angle ring 460 is secured to the inside of dial 455 by bolts 461. An external worm gear 462 is formed around the periphery of ring 460, said gear meshing with a worm 463 secured to a shaft 464. Shaft 464 is mounted in bearings 465 and a bevel gear 466 is secured to one end of shaft 464 and meshes with a bevel gear 467 secured to a handwheel shaft 468. The shaft 468 is rotatably mounted on disc 458 and a handwheel 469 with handle 470 is secured to the outer end of shaft 468. By manually turning the handle 470, disc 458 is rotated relative to dial 455. In order to lock the disc 458 to dial 455 in any desired position, a handled screw 471 engages the disc 458, said screw having a frusto conical wedge surface 471*a* which engages a ball 471*b* mounted in a ball housing 471*c*. A brake block 471*d* is slidably mounted in the housing 471*c* and is pressed inwardly against the edge of the angle ring 460 when screw 471 is tightened. The screw 471 is terminated in a guide pin 471*e* which extends through the housing 471*c* to counteract the pressure of the ball 471*b*.

An actuating pin 472 is secured to the inside of disc 458 so that, when said disc 458 rotates, the pin 472 strikes against the lower end of a lever 486 which is secured to a rockshaft 476 outside of the box 429. A bell crank lever 474 is pivotally mounted on shaft 476 inside the box 429, said lever 474 having outstanding switch arms 473 and 475. A switch starting lug 477 is secured by bolts 478 to the gear 452 and, when said gear rotates in a clockwise direction (Fig. 17), the lug 477 engages the switch arm 473 to rock the lever 474 in a counterclockwise direction to operate a snap switch 479 and start the operation of the counting mechanism to be subsequently described. The counterclockwise movement of lever 474 is limited by contact of the lever arm 473 with the inner end of a stop pin 480 which is adjustably supported in a fixed bearing 481 formed on the box 429 and a bearing 482 also formed on said box. The outer end of pin 480 has a threaded section 483 which engages the bearing 482, a lock nut 484 serving to secure said pin in the desired adjusted position. A lever 485 is also secured to the shaft 476 and rocks when said shaft 476 rotates. Stop lugs 487 and 488 are secured to the outside of box 429 so as to limit the rocking movement of lever 466.

The snap switch 479 is provided with outstanding arms 491 and 492, pins 493 and 494 being secured to the outer ends of said arms 491 and 492, respectively. Bell crank levers 495 and 496 are pivotally mounted on pins 493 and 494, respectively, so as to rock on said pins. Arms 497 and 498 of said levers 495 and 496, respectively, are provided with rollers 499 and 500, respectively. Roller 499 periodically engages the lever 485 and roller 500 engages the lever arm 475. Lever arms 501 and 502 are formed on levers 495 and 496, respectively, and the outer ends of said lever arms 501 and 502 are bifurcated to engage a switch rod 503 provided with limiting nuts 504. The mechanism described moves the rod 503 axially so as to actuate a snap switch member 505 to the right and to the left so as to close a circuit and open the opposite circuit when in extreme positions. The dial 455 is provided with graduations 507 around its periphery and an indicator or pointer 508 and is secured to disc 458 by screws 509. By turning the handwheel handle 470, the distance between pin 472 and lug 477 can be changed to cutoff

sheets of expanded metal of different widths, as desired.

A countershaft 510 is secured in a bearing 511 formed on the inside of box 429 and a ratchet wheel 512 is rotatably mounted on said shaft 510. A spur gear 513 is secured to the ratchet wheel 512 and meshes with the gear 452. A pawl is pivotally mounted upon a pin 516, said pin being secured to a lever 517 which is rotatably mounted at one end of a fixed pin 518. A knife edge 519 is formed on one end of lever 515 so as to engage teeth 520 of the ratchet wheel 512. The opposite end of lever 515 is connected by a tension spring 521 to a pin 522 secured to lever 517. The upper end of lever 517 is provided with a pin 523 and a link 524 is pivoted to said pin 523. A threaded stud 525 extends through the upper end of link 524, being provided with locking nuts 526a to position the link 524 axially on the piston rod 525. The opposite end of piston rod 525 extends into the cylinder 428 and is provided at its inner end with a piston 526. A piston head 527 closes one end of cylinder 428 and compressed air pipe line 427 extends into said cylinder 428 through the head 527. A compression spring 529 is mounted on the piston rod 525 inside the cylinder 428 so as to normally urge the piston 526 to the left. The movement of piston 526 to the right under the action of the compressed air introduced through pipe 427 is limited by a stop bolt 530 which is threaded to engage the box 429 and is locked in place by lock nut 531.

A locking pawl lever 532 is pivotally mounted on the pin 518 and is provided at one end with a knife edge 533 which engages the ratchet teeth 520 to hold the ratchet wheel 512 while the knife edge 519 is engaging the next tooth of said ratchet wheel 512. The opposite end of lever 532 is provided with a tension spring 534 connected to a fixed pin 535 so as to normally urge the knife edge 533 into contact with the ratchet teeth 520. An electric switch 536 is mounted below the lever 532 and an adjustable pin 537 carried by the lever 532 engages a push pin 538 on switch 536 for operating said switch. The extreme end of lever 532 is pivotally connected by link 539 to a solenoid core 540 which is mounted for axial reciprocation in a solenoid 541. A switch arm 542 is also connected to the lever 532 and is provided with a push pin 543 mounted to engage an actuating pin 544, said pin 544 being mounted for axial reciprocation in an electric switch 545.

A radially extending arm 547 (Fig. 23) protrudes from shaft 144 and a switch arm 548 is provided with a roller 549 which lies in the path of travel of the end of arm 547. The switch arm 548 is pivotally mounted on a pin 550 which is rotatably mounted in a switch box 551, said box being secured to a bracket 552 by bolts 553. Thus for every revolution of shaft 144 and for every two revolutions of shaft 72, the circuit controlled by switch 551 is opened, and during the remainder of the rotation of the shaft 144, the switch 551 is closed. The purpose of switch 551 is to start a new cycle of counting and expanding after each cut-off so that the sheet of expanded metal has a closed diamond at each corner, the switch arm 547 providing the correct timing relation for each operation of switch 551.

A cam 555 is mounted on shaft 72, said cam being adjustable relative to the shaft 72 by means of bolts 556. The switch arm 557 is positioned adjacent the cam 555, said arm being provided with a roller 558 which engages the periphery of cam 555 since the switch arm 557 is secured to a pivot pin 559 which extends rotatably onto an electric switch 560. The cam 555 normally holds the switch 560 open during most of its revolution but a depressed segment 561 on said cam permits the roller 558 to close the switch 560 and electrical circuit controlled thereby. This switch 560 operates the solenoids 386 which control air valves 385, said valves 385 operating the feed brake pistons 183 to control the feeding of the sheet to the cutter knives 98. A solenoid 563 operates the valve 411 so as to control the operation of the hold-down cylinders 347 and cylinders 415 and 428. Manually controlled switch 564 of the push-button type is used to shunt out the automatic control on the sheet feeding brake cylinders 182 and permits the feeding mechanism to be advanced or retarded by the operator. A manually operated switch 566 of the push-button type shunts out the automatic control in the timing box 429 and permits a cut-off stroke to be made at any time by the operator. A starting button 567 and stop button 568 and a jog button 569 are provided on the box 429 for controlling the operation of the main motor 50.

In order to more fully describe the operation of the various electrical circuits, the electrical lines connecting the various switches and solenoids will be listed below in tabular form.

No. of electric line	Parts connected
575, 576	Main supply lines 440 volts D. C.
577	575 and switch 560.
578	Switch 560 and switch 545.
579	Switch 545 and solenoid 386.
580	Solenoid 386 and line 576.
581	Line 575 and switch 564.
582	Switch 564 and solenoid 386.
583	Solenoid 386 and line 576.
584	Line 575 and solenoid 563.
585	Solenoid 563 and switch 566.
586	Switch 566 and switch 479.
587	Switch 479 and solenoid 563.
588	Solenoid 563 and switch 551.
589	Switch 551 and switch 479.
590	Switch 479 and solenoid 541.
591	Switch 536 and line 576.
592	Switch 536 and switch 479.
593	Line 586 and line 591.
594	Line 584 and solenoid 541.

After the expanded metal has been formed by the agencies heretofore described, it passes downwardly from the knives 98, and the sheet has a tendency to curl inwardly. To correct this condition and to produce a sheet of expanded metal which is substantially flat, we provide a plate guide 600 which extends downwardly at an angle from knives 98. The angle which this guide plate makes with the vertical can be changed as necessary when expanded metal of different types and sizes are produced. The lower face of plate 600 is provided with a number of brackets 601 to each of which is pivotally connected a bolt 602 by means of a pin 603. An angle bar 604 extends transversely of the machine and a plurality of spaced blocks 605 is secured to said bar 604. Each bolt 602 passes through a block 605 and is secured in vertical axial position by lock nuts 606 and 607. Brackets 608 are secured to frame 609 of the machine by bolts 610 and serve to support the angle bar 604. Additional blocks 611 are secured to the bar 604 and a bolt 612 is rotatably mounted in each of the blocks 611. One end of each bolt 612 is threaded into the frame member 609 and the axial position of bolt 612 and the angle of guide plate 600 is determined by the position of a lock nut 613 on bolt 612, which bears against the frame member 609. The plate 600 is thus adjusted to exactly neutralize the tendency

of the sheet of expanded metal 614 to curve inwardly. An angle bar 615 extends downwardly from each block at an angle to form a slide for conveying the expanded metal sheet 614 to the floor.

Operation

In starting the machine the operator presses starting button 567, thus starting the operation of motor 50 which vertically and continuously reciprocates the crosshead 78 carrying slitting and expanding knives 98, said knives cooperating with lower knife 100 to form a sheet 614 of expanded metal of an advancing sheet of metal 171. Knives 98 are mounted on slide carrier 103 which is reciprocated transversely the length of half a diamond by double acting piston 132 which is reciprocated by compressed air through pipes 138 and 140. Compressed air valves 142 are operated by cams 149c on a shaft 144 which is rotated by chain 146 from shaft 72. With the knives 98 in operation, the operator reverses air valve handle 378 and presses switch 564 which shunts out limit switch 560 (Fig. 43) and causes solenoids 386 to become energized, thus releasing feed brake shoes 179 and 180 and permitting the feed mechanism 172 to 197 and 205 to 209 to move rearwardly on racks 171a to its extreme limit. The operator now lays a sheet of metal 171 on table 170, reverses air valve handle 378, and again presses switch 564, causing the sheet 171 to move forwardly under the control of the operator nearly up to knives 98. He then releases switch 564 to permit the automatic control to become operative. At this stage, the following conditions prevail:

All circuits are momentarily dead not illustrated) as switches 560, 564, 566 and 536 are open. The rotation of cam 555 now closes switch 560 (Fig. 41) energizing lines 575, 577, 578, 579, 580, 583 and 576, and energizing solenoids 386 so that valves 385 are opened momentarily actuating feed brake pistons 183 and permitting the sheet to advance slightly toward knives 98 under the action of feed pistons 197. Switch 545 is normally closed, permitting the feed to operate at each stroke of knives 98 under the action of cam 555. Switch 551 is being momentarily opened each two revolutions of cam shaft 72, but, since lines 591 and 592 are normally open at switch 536, no action takes place. Solenoid 541 is not energized except at cutoff, since it is in parallel with solenoid 563, which is normally dead except at cutoff.

As soon as the sheet 171 has been advanced into the cutters 98 and a stroke or two made in order to straighten up any camber that might be present in the sheet, the operator presses switch 566. As soon as this is done, the following takes place (Fig. 43).

Lines 576, 591, 593, 586, 585, 584, 575, 587, 590 and 594 are energized, thus energizing solenoids 563 and 541. Valve 411 is operated by solenoid 563, which exhausts the air from the lower side of hold-down cylinders 347 and admits air to the top side of the hold-down cylinders 347, which causes hold-down bar 321 to clamp on the sheet 171. Solenoid 541 is energized simultaneously with solenoid 563 and pulls down, drawing the locking pawl knife edge 533 out of engagement with ratchet teeth 520. When the locking pawl 532 is disengaged by solenoid 541, it closes switch 536 and opens switch 545. In closing switch 536, the parallel branch circuit through lines 591, 592, switch 505, line 589, switch 551, and line 588 is closed so that solenoid 541 would remain energized momentarily even if switch 566 is released, to permit complete rewind of dial 455. In opening switch 545, the circuit to solenoids 386 is opened, thus rendering the feed brake cylinders 182 inoperative during the cutoff cycle. Since the feed of sheet 171 was stopped and the hold-down clamped, the sheet does not make its next regular feed, and, as a result, the knives 98 on the next stroke strike on the bonds of the mesh formed on the preceding stroke so as to sever a sheet of expanded metal 614 from the metal sheet 171.

As soon as solenoid 541 is energized to release the locking pawl 532, shaft 453, dial 455 and related parts rotate in a clockwise direction, under the action of motor 433 and friction clutch 447 (Fig. 17), until lug 477 strikes switch arm 473 to throw switch 505 to the right (Fig. 40), thus opening the circuit through lines 586 and 587 to start a new cycle of cutting as soon as switch 551 is closed mechanically. When a predetermined number of strokes form a sheet of expanded metal of desired width determined by the distance between lug 477 and pin 472, said pin 472 strikes the lever 486 to throw switch 505 to the left to automatically energize the solenoid 541 and start the rewind as previously described to start a new cycle of cutting. Each stroke of the knives 98 causes air valve 415 to be momentarily opened and closed by cam 419 so as to actuate air piston 526, which rocks lever 517 and pawl 515 to move the ratchet wheel 512 the distance of one tooth 520. Counting air piston 526 only operates when air pressure exists in the bottom of hold-down cylinders 347, but, when this air is exhausted by action of solenoid 563, piston 526 is not actuated, as no air passes through valve 415 even though cam 419 continues to operate.

Just preceding the first stroke on a new cutting cycle, mechanically operated switch 551 (Fig. 40) is closed, but cam arm 547 then opens switch 551 which breaks the circuit to solenoid 563. This in turn reverses the air in hold-down cylinders 347, permitting the hold-down bar 321 to be actuated normally by hold-down cams 342 and admitting air through valve 415 to indexing cylinder 428. When switch 551 is opened, this also opens the circuit through solenoid 541 and permits the pawls 515 and 532 to drop into their regular position for indexing and locking. When the locking pawls 515 and 532 resume their normal position, switch 545 is closed (Fig. 41), thus permitting feed brake solenoids 386 to become operative through cam 555 and switch 560. Switch 551 is opened mechanically at exactly the right moment when knives 98 are in correct horizontal position so as to produce expanded metal sheets 614 having closed diamonds at all four corners.

The cutting cycle is repeated automatically until all material except the selvage edge scrap is expanded. The operator then closes switch 566, which cuts off any extra strands by clamping the strip with hold-down bar 321. With this switch 566 closed, he reverses air valve handle 391, thus reversing the air in back finger cylinders 290 and causing the cam shaft 235 and fingers 217 to draw forwardly from their normal position near the knives 98. He then opens switch 566, and, as soon as switch 551 opens to release the hold-down bar 321, he closes switch 564, which releases the feed brake pistons 183, and the feed mechanism advances, pushing out the selvage strip or scrap.

Gauging fingers 217 are reciprocated by cams

234 on shaft 235 so as to gauge the width of strand at each stroke. Fingers 217 are also depressed at each stroke by bars 266 which engage bars 220. Guide 600 prevents inward curling of expanded metal sheet 614, the angle of said guide being adjustable by nuts 606, 607, and 613. The tension in driving belts 67 is adjusted by nut 61 which changes the angle of motor platform 51. The distance between lug 477 and pin 472 is adjusted by loosening locking handle 471 and then turning handle 470 to change the width of the expanded metal sheet 614. Jog button or switch 569 is used to momentarily start and stop the motor 50. Hydraulic piston 152 serves to cushion the reciprocation of knives 98 and related parts transversely of the machine.

We would state in conclusion that, while the illustrated example constitutes a practical embodiment of our invention, we do not wish to limit ourselves precisely to these details, since manifestly the same may be considerably varied without departing from the spirit of the invention as defined in the appended claims.

Having thus described our invention, we claim as new and desire to secure by Letters Patent:

1. In a machine for producing expanded metal, means for actuating single acting shearing and expanding knives to produce expanded metal from an advancing sheet of metal, compressed air actuated means for stopping the advance of said metal sheet after a predetermined width of sheet of expanded metal has been formed so as to cut off said sheet of expanded metal, and electrical means for controlling the operation of said compressed air actuating means.

2. In a machine for producing expanded metal, means for vertically reciprocating shearing and expanding knives to produce expanded metal from an advancing sheet of metal, compressed air actuated means for reciprocating said knives transversely of said machine, and means for cutting off said expanded sheet to the desired width.

3. A machine as described in claim 2 characterized by mechanical means for controlling the operation of said compressed air actuated means at each vertical stroke of said knives.

4. In a machine for producing expanded metal, means for actuating shearing and expanding knives to produce expanded metal from an advancing sheet of metal, a counting dial, compressed air actuated means associated with said dial for actuating said dial at each stroke of said knives, means associated with said counting dial for cutting off a sheet of expanded metal of predetermined width, and electrical means for controlling the operation of said dial.

5. In a machine for producing expanded metal, means for actuating shearing and expanding knives to produce expanded metal, means for intermittently feeding a sheet of metal toward said knives, brake means associated with said feed means to intermittently stop the operation of said feed means, and compressed air actuated means for actuating said brake means.

6. A machine as described in claim 5 characterized by electrical means for controlling the operation of said brake means.

7. In a machine for producing expanded metal, means for vertically reciprocating shearing and expanding knives to produce expanded metal, a flywheel associated with said reciprocating means, brake means associated with said flywheel to stop the rotation thereof, and compressed air actuated means for actuating said brake means.

8. In a machine for producing expanded metal, means for actuating shearing and expanding knives to produce expanded metal, means for feeding a sheet of metal toward said knives, a first compressed air actuated means for continuously urging said feeding means and sheet of metal toward said knives, and a second compressed air actuated means independent of said sheet for intermittently making said first compressed air means ineffective to feed said sheet.

9. In a machine for producing expanded metal, means for actuating shearing and expanding knives to produce expanded metal, means for feeding a sheet of metal toward said knives, stop fingers for engaging said sheet at each stroke of said knives so as to control the width of strand of said expanded metal, means for withdrawing said fingers to eject a piece of scrap metal from said machine, and compressed air actuated means for actuating said withdrawing means.

10. In a machine for producing expanded metal, slitting and expanding knives, means for actuating said knives to produce expanded metal from an advancing sheet of metal, means for advancing said sheet of metal toward said knives, and interacting compressed air means and electrical means for controlling the movement of said sheet and to automatically cut off a sheet of expanded metal of predetermined width.

11. In a machine for producing expanded metal, slitting and expanding knives, means for actuating said knives to produce expanded metal from an advancing sheet of metal, means for advancing said sheet of metal toward said knives, a hold-down element adapted to stop the movement of said sheet of metal, compressed air actuated means for applying said hold-down element to said sheet of metal, an electrical solenoid controlling the operation of said compressed air actuated means, an electrical circuit associated with said solenoid, and means for energizing said circuit at predetermined intervals.

12. A machine as described in claim 11 characterized by a second solenoid in parallel with said first solenoid and energized simultaneously therewith, and a strand counting device associated with said second solenoid.

13. In a machine for producing expanded metal, slitting and expanding knives, means for actuating said knives to produce expanded metal from an advancing sheet of metal, means for feeding said sheet of metal toward said knives, a hold-down element adapted to stop the movement of said sheet of metal, an electrical solenoid controlling the operation of said compressed air actuated means, an electrical circuit associated with said solenoid, brake means for stopping the operation of said feeding means, compressed air actuated means for operating said brake means, an electrical circuit and a solenoid associated with said brake means, and means for alternately energizing the circuits of said first and second solenoids.

14. In a machine for producing expanded metal, reciprocating slitting and expanding knives, means for actuating said knives to produce expanded metal from an advancing sheet of metal, means for feeding said sheet of metal toward said knives, brake means for stopping the operation of said feeding means, compressed air actuated means for operating said brake means, a solenoid for controlling the operation of said air actuated means, and means for intermittently energizing said solenoid.

15. A machine as described in claim 14 char-

acterized by an electrical circuit associated with said solenoid, a switch in said circuit, and cam means for closing said switch at every stroke of said knives.

16. In a machine for producing expanded metal, reciprocating slitting and expanding knives, means for actuating said knives to produce expanded metal from an advancing sheet of metal, automatic means for counting the number of strands produced by said knives, compressed air actuated means for operating said counting means, and a cam for actuating said compressed air means at a stroke of said knives.

17. In a machine for producing expanded metal, vertically reciprocating slitting and expanding knives, means for actuating said knives to produce expanded metal from an advancing sheet of metal, compressed air actuating means for reciprocating said knives horizontally, and cam means for actuating said compressed air means at each vertical stroke of said knives.

18. In a machine for producing expanded metal, reciprocating slitting and expanding knives, means for actuating said knives to produce expanded metal from an advancing sheet of metal, means for feeding said sheet, compressed air actuated means for stopping the feeding of said sheet, a solenoid associated with said stopping means, an electrical circuit associated with said solenoid, and a manually controlled switch for causing said solenoid to become energized.

19. In a machine for producing expanded metal, vertically reciprocating slitting and expanding knives, means for actuating said knives to produce expanded metal from an advancing sheet of metal, a hold-down element for stopping the feeding of said sheet toward said knives, compressed air actuated means for operating said hold-down element, an electrical solenoid associated with said air actuated means, an electrical circuit connecting said solenoid with a source of current, automatic means for energizing said solenoid at each stroke of said knives, and a manually controlled switch in said circuit to shunt out said automatic means and energize said solenoid.

20. In a control mechanism for machines for producing expanded metal, a rotatably mounted shaft, a counting dial mounted on said shaft, a ring-like disc rotatably mounted on said dial for rotary movement relative to said dial, means for adjusting the relative position of said dial and disc, an electric switch adjacent said dial, a pair of switch actuating members associated with said disc and dial, and means for rocking said shaft so as to operate said switch and control the cut-off operation of said expanded metal machine.

21. A control device as described in claim 20 characterized by ratchet and pawl means for causing the intermittent rotary movement of said shaft.

22. In a control mechanism for machines for producing expanded metal, a rockshaft, an electrical switch mounted adjacent said rockshaft, driving means having a friction clutch urging said rockshaft for movement in one direction, ratchet and pawl means for urging said rockshaft to rotate in the opposite direction, and a plurality of relative adjustable switch operating members associated with said shaft for operating said switch and controlling the operation of said expanded metal machine.

23. A device as described in claim 22 characterized by electrical and compressed air actuated means for controlling the operation of said ratchet and pawl and the rocking of said shaft.

24. A device as described in claim 22 characterized by a plurality of electrical control switches adapted to be opened and closed by the operation of said ratchet and pawl mechanism.

25. A device as described in claim 22 characterized by an electrical solenoid for actuating said ratchet and pawl mechanism and for controlling the rocking of said shaft.

26. In a machine for producing expanded metal, slitting and expanding knives, means for actuating said knives to produce expanded metal from an advancing sheet of metal, means for advancing said sheet of metal toward said knives, a hold-down element adapted to stop the movement of said sheet of metal, cam means for operating said hold-down element, compressed air actuated means for operating said hold-down element independently of said cam means, and electrical means for controlling the operation of said air actuated means.

27. In a machine for producing expanded metal, slitting and expanding knives, means for vertically reciprocating said knives to produce expanded metal from an advancing sheet of metal, means for advancing a sheet of metal toward said knives, a hold-down element for holding down said sheet during a cutting stroke of said knives, means for automatically counting the number of strokes of said knives, brake means for starting and stopping the feeding of said sheet, means for horizontally reciprocating said knives, and compressed air actuated means for actuating said advancing, hold-down, counting and reciprocating means.

28. A machine as described in claim 27 characterized by electrical means for automatically controlling the operation of said compressed air actuated means.

29. In a machine for producing expanded metal, means for actuating slitting and expanding knives to produce expanded metal, means for feeding a sheet of metal toward said knives, stop fingers for engaging said sheet at each stroke of said knives so as to control the width of strand of said expanded metal, and cam means for reciprocating said fingers.

30. A machine as described in claim 29 characterized by compressed air actuated means for disengaging said cam means.

31. A machine as described in claim 29 characterized by means for depressing said fingers at each stroke of said knives.

32. An automatic machine for producing expanded metal comprising vertically and horizontally reciprocating single acting knives operable to produce expanded metal from an advancing sheet of metal, means to continuously operate said knives, means to feed a sheet of metal step by step to said knives in a straight line, and means independent of said sheet to interrupt said feeding means for a single step at predetermined steps.

33. An automatic machine for producing expanded metal comprising vertically and horizontally reciprocating single acting knives operable to produce expanded metal from an advancing sheet of metal, means to continuously operate said knives, means to feed a sheet of metal step by step to said knives in a straight line, means independent of said sheet to interrupt said feeding means for a single step at two spaced points of feed, and means to predetermine the number of steps between said interrupted steps.

34. An automatic machine for producing expanded metal comprising vertically and horizontally reciprocating single acting knives operable to produce expanded metal from an advancing sheet of metal, means to continuously operate said knives, means to feed a sheet of metal step by step to said knives in a straight line, means independent of said sheet to interrupt said feeding means for a single step at two spaced points of feed, and means to predetermine the number of steps between said interrupted steps, said predetermining means being operatively related to said interrupting means to cause said sheet to be cut off during each interruption in a manner to produce closed diamonds at all four corners of the finished sheet of expanded metal.

35. In a machine for producing expanded metal, means for actuating single acting shearing and expanding knives to produce expanded metal from an advancing sheet of metal, means to advance said sheet, means independent of said sheet to interrupt the advance thereof after a predetermined number of diamonds have been cut, automatic means to cause said knives to cut from said metal sheet a sheet of expanded metal of predetermined width, and automatically operable means to synchronize the movement of said metal sheet with the movements of said knives to cut said metal in a predetermined relation to the expanded mesh to provide a closed diamond at each corner of the cut off sheet.

36. In a machine for producing expanded metal, means for actuating single acting shearing and expanding knives to produce expanded metal from advancing sheet metal, automatically operable means to advance said sheet metal step by step, means under manual control to interrupt the advancement of said sheet metal for one step to enable said knives to cut off a narrow strip of said metal to align the advancing edge with said knives and then automatically resume normal shearing and expanding operations, means automatically synchronizing said controlled means with said knives to cause the first resumed cut and expansion to provide closed diamonds at the advancing corners of said sheet, and presettable means to automatically control said sheet advancing means to again interrupt the advancement of said metal for one step after a number of steps predetermined by said presettable means to enable said knives to cut off a sheet of expanded metal with closed diamonds at all corners thereof.

37. An automatic machine for producing expanded metal comprising means for actuating single acting shearing and expanding knives to produce expanded metal from an advancing sheet of metal, compressed air actuated means for interrupting the advance of said metal sheet after a predetermined width of sheet of expanded metal has been formed so as to cut off the expanded metal, electrical means for controlling the operation of said compressed air means, and manually settable means for timing the operation of said electrical means with respect to said advancing sheet.

38. In a machine for producing expanded metal, means for actuating shearing and expanding knives to produce expanded metal, means for feeding a sheet of metal toward said knives, compressed air means for continuously urging said feeding means and sheet of metal toward said knives, and means independent of said sheet for making said compressed air means temporarily ineffective for feeding at one or more predetermined points in the feeding movement.

39. In a machine for producing expanded metal, vertically reciprocating slitting and expanding knives, means for actuating said knives to produce expanded metal from an advancing sheet of metal, a hold-down element intermittently operative for stopping the feeding of said sheet toward said knives, means for actuating said hold-down element to enable feeding of said sheet continuously step by step, and manually operable means for controlling said actuating means to cause said hold-down to remain in holding position throughout any selected normal step period.

40. In a machine for producing expanded metal, means for continually actuating single acting shearing and expanding knives to produce expanded metal from an advancing sheet of metal, a continually operable sheet advancing means, a continually operable hold-down means, and presettable control means for automatically controlling said machine to cut off said sheet of expanded metal after a predetermined number of diamonds of expanded metal have been formed, said control comprising means to interrupt the operation of said hold-down means in hold-down position at predetermined intervals, and means to make said sheet advancing means ineffective during said predetermined hold-down interval.

41. In a machine for producing expanded metal, means for actuating shearing and expanding knives to produce expanded metal from an advancing sheet of metal, a counting dial, a hold-down means, a sheet advancing means, fluid operating means for said hold-down, fluid operating means for said sheet advancing means, fluid actuated means associated with said dial for actuating said dial at each stroke of said knives, and means controlled by said counting dial for independently controlling both fluid operating means to cut off a sheet of expanded metal of predetermined width.

42. In a machine for producing expanded metal, means for continually actuating single acting shearing and expanding knives to produce expanded metal from an advancing sheet of metal, an intermittently operable sheet advancing means, compressed air actuated means to intermittently energize said sheet advancing means, and presettable means for controlling said sheet advancing means for stopping the advance of said metal sheet after a predetermined width of sheet of expanded metal has been formed so as to cut off said sheet of expanded metal.

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