March 7, 1944.

E. H. KOCHER

2,343,302

LUBRICATION

Filed Aug. 3, 1940

4 Sheets-Sheet 1

FIG. 1.

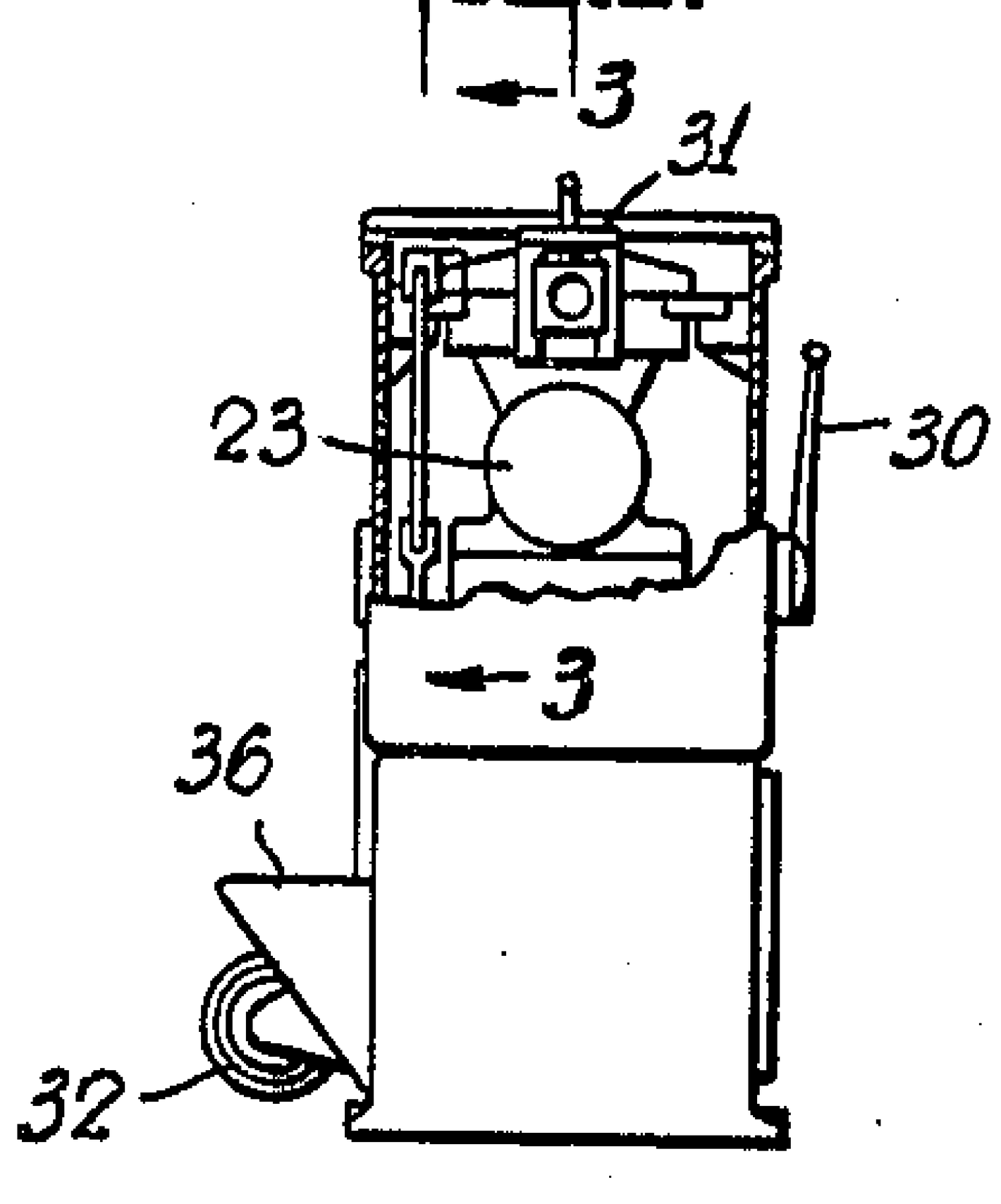

FIG. 2.

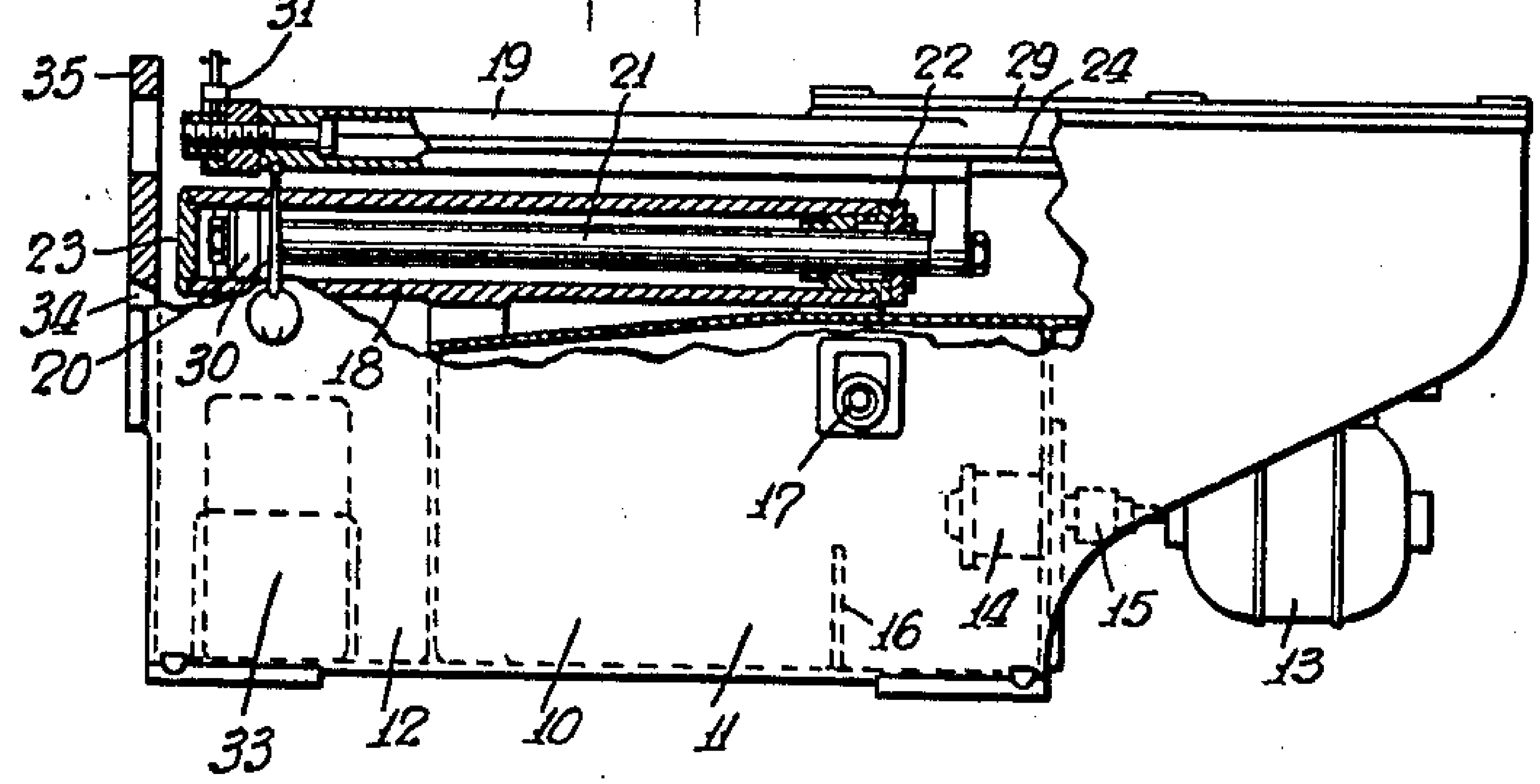

FIG. 3.

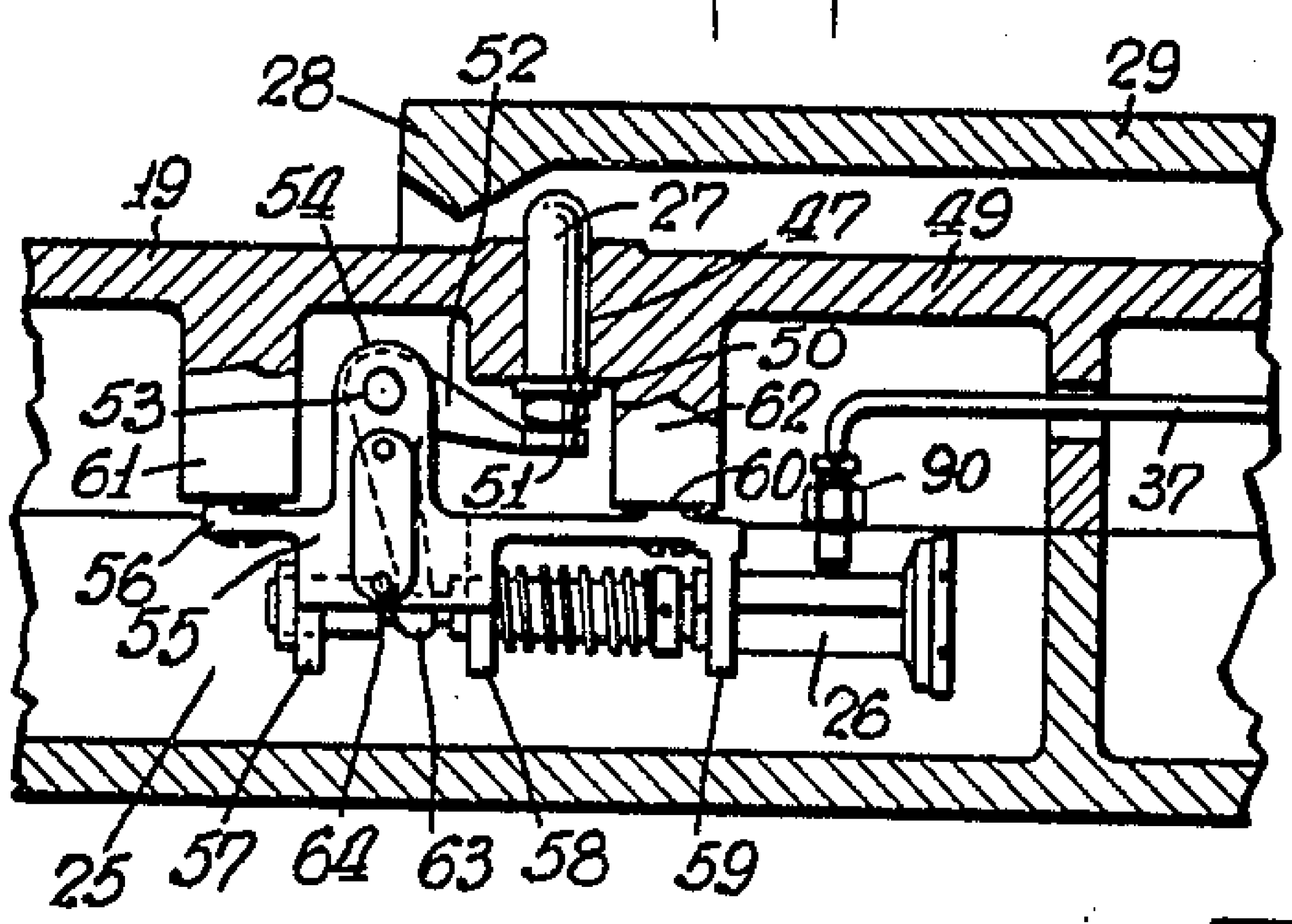

FIG. 5.

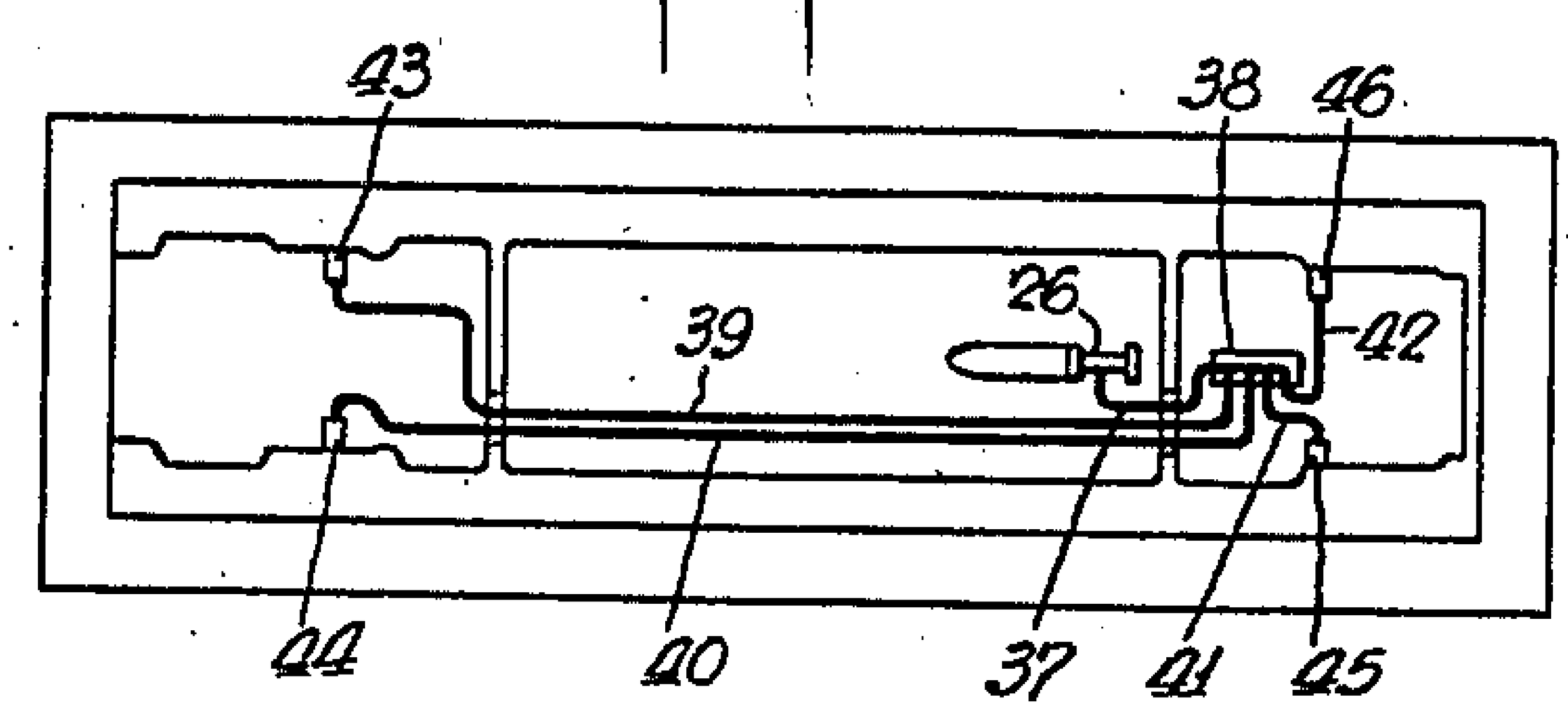

FIG. 4.

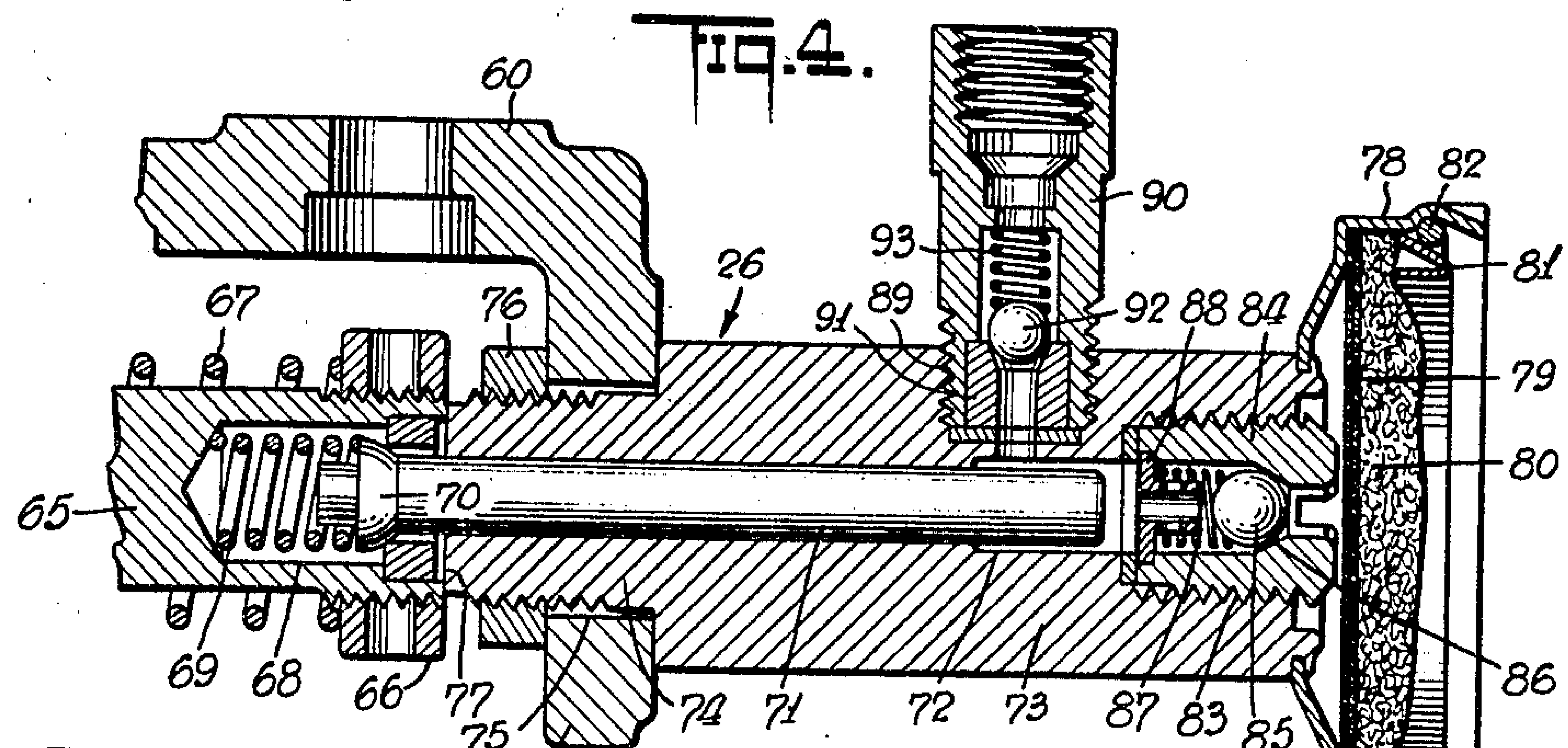

FIG. 6.

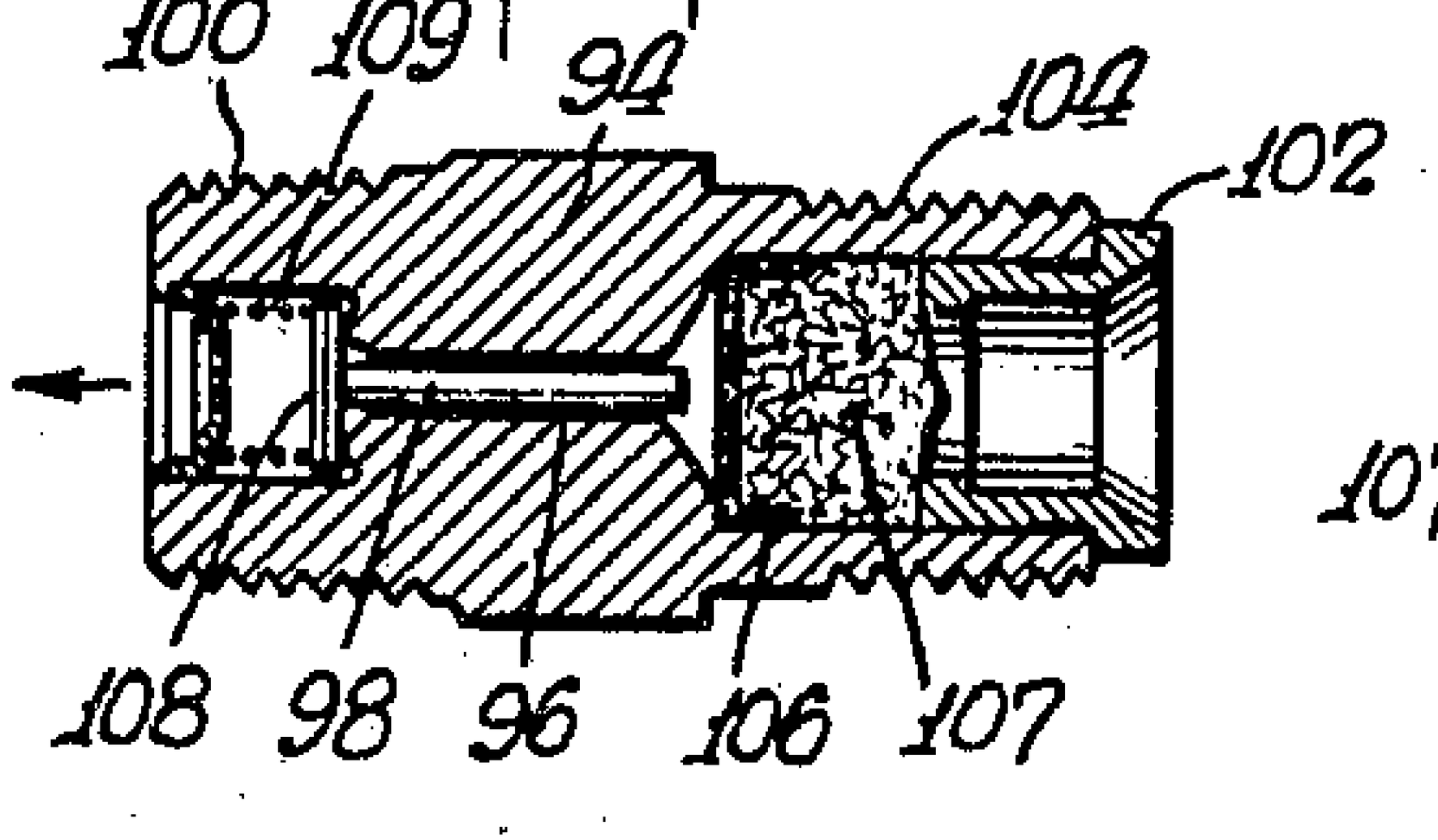

FIG. 7.

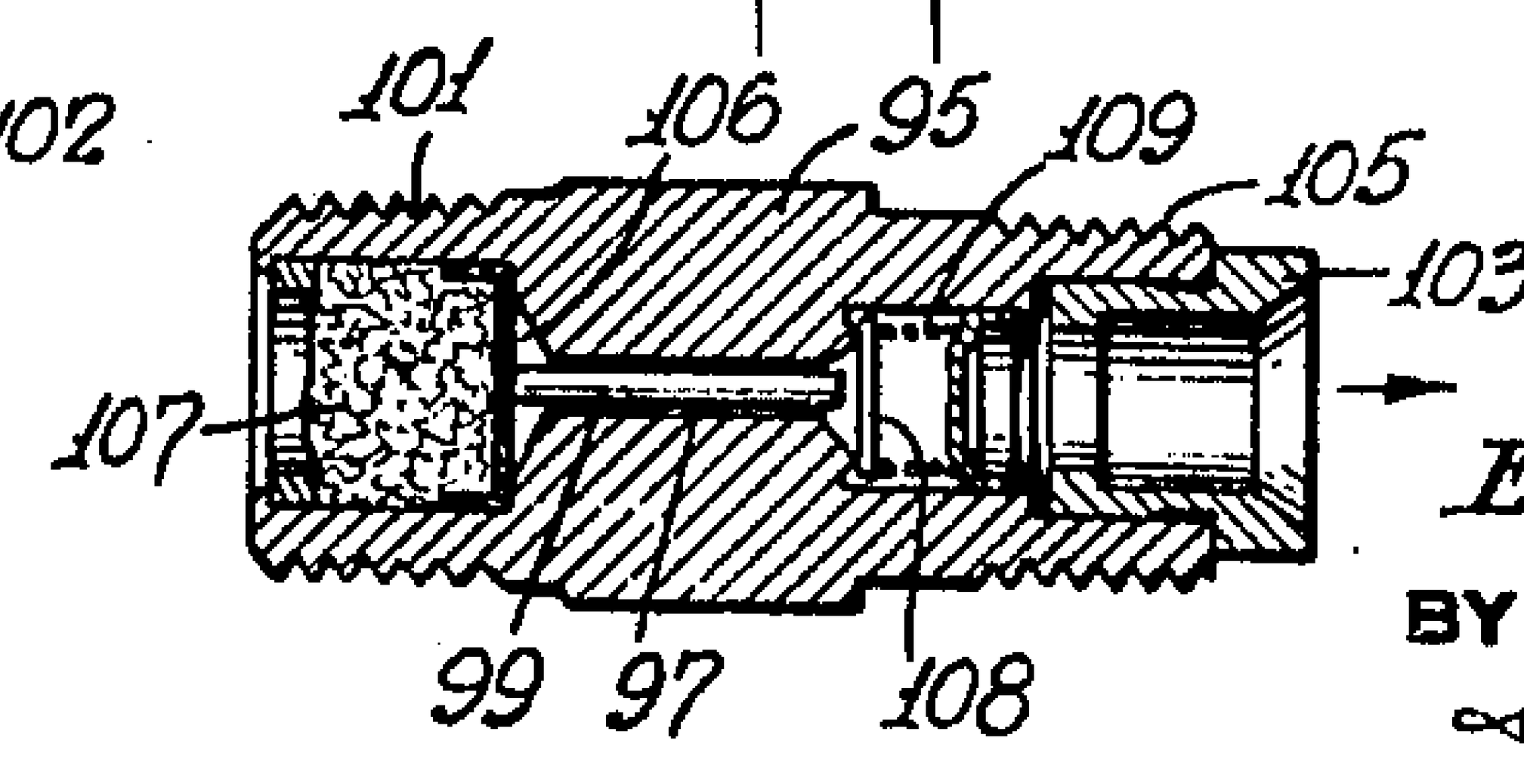

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Fig. 8.

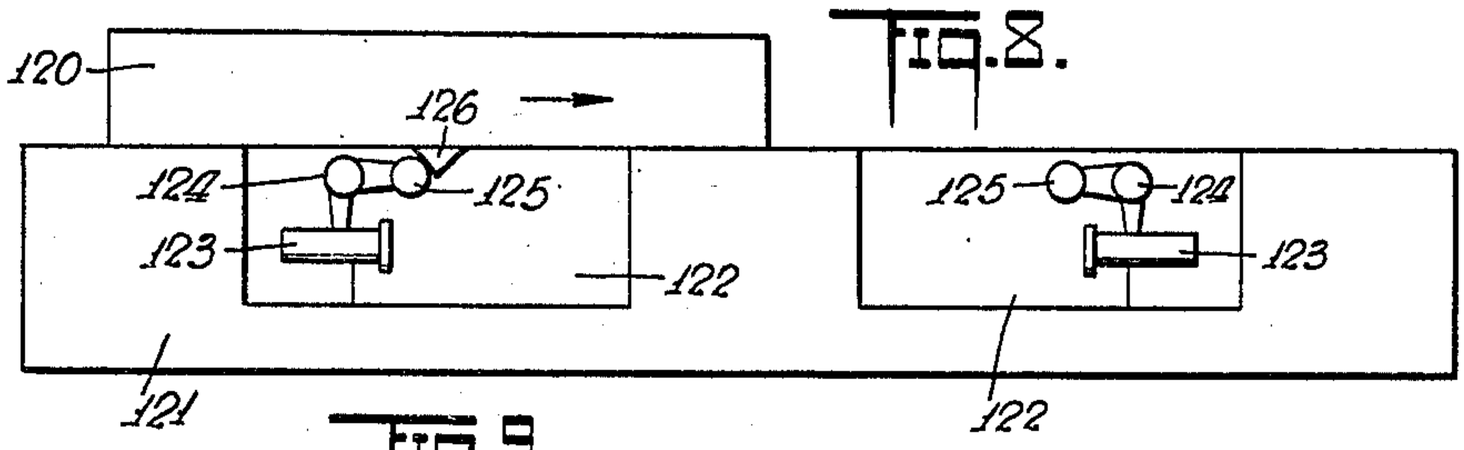


Fig. 9.

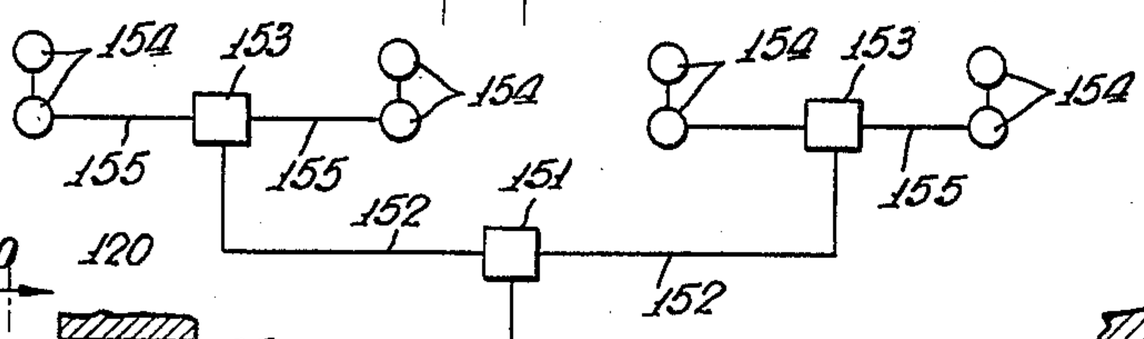
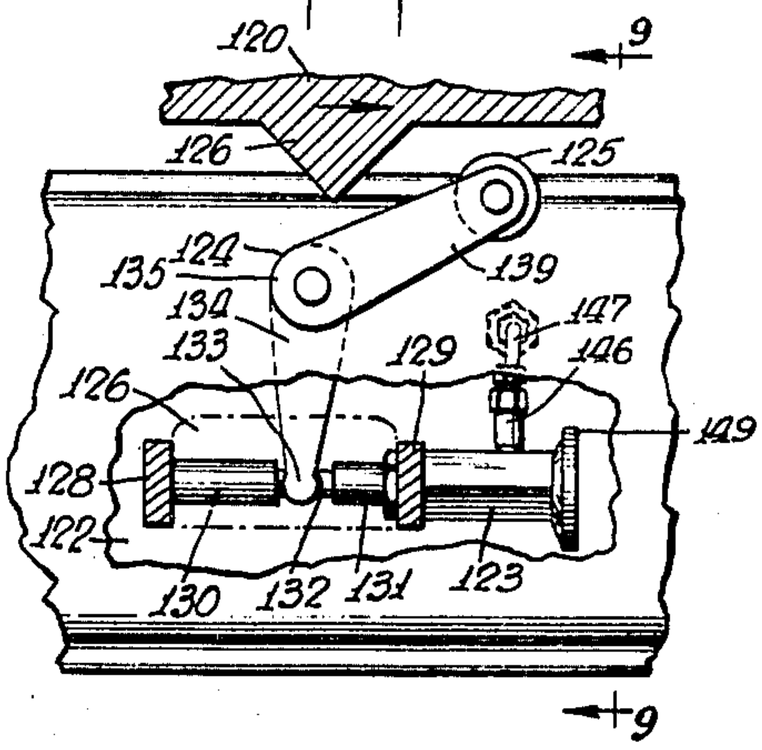


Fig. 10.



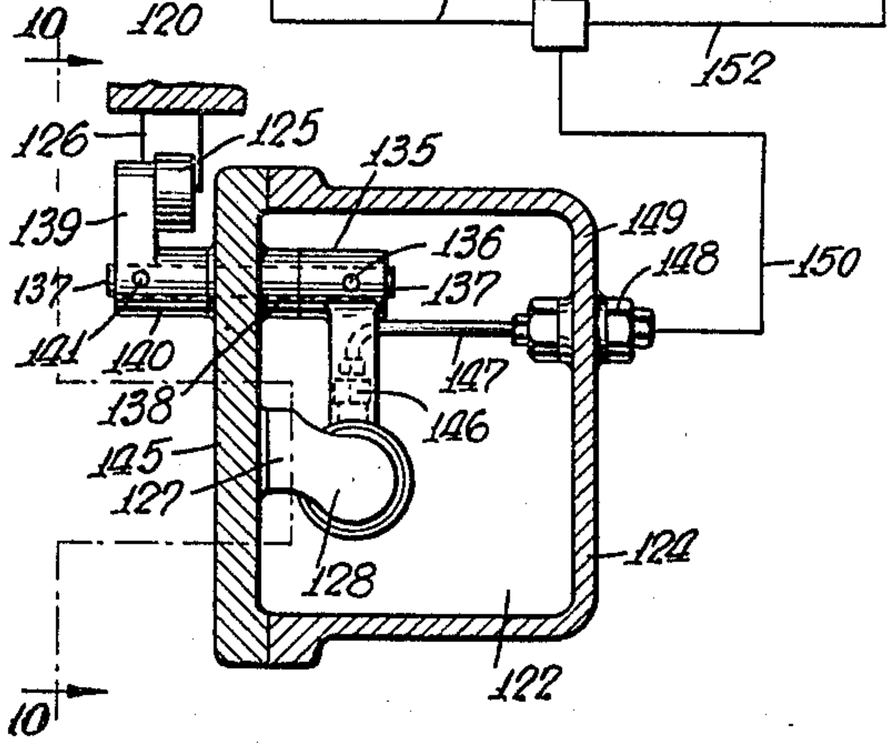


Fig. 11.

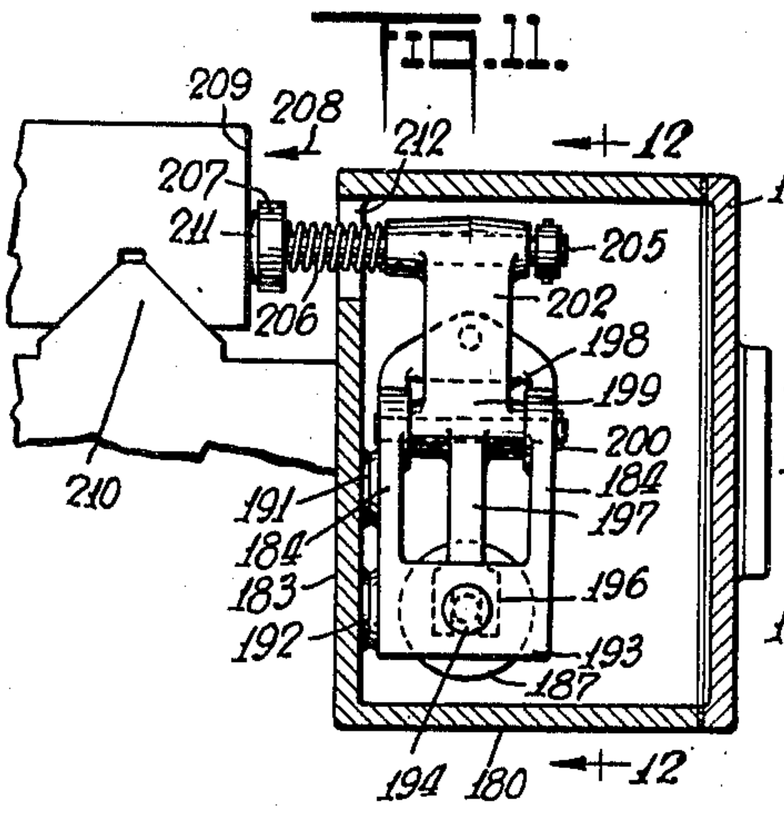


Fig. 12.

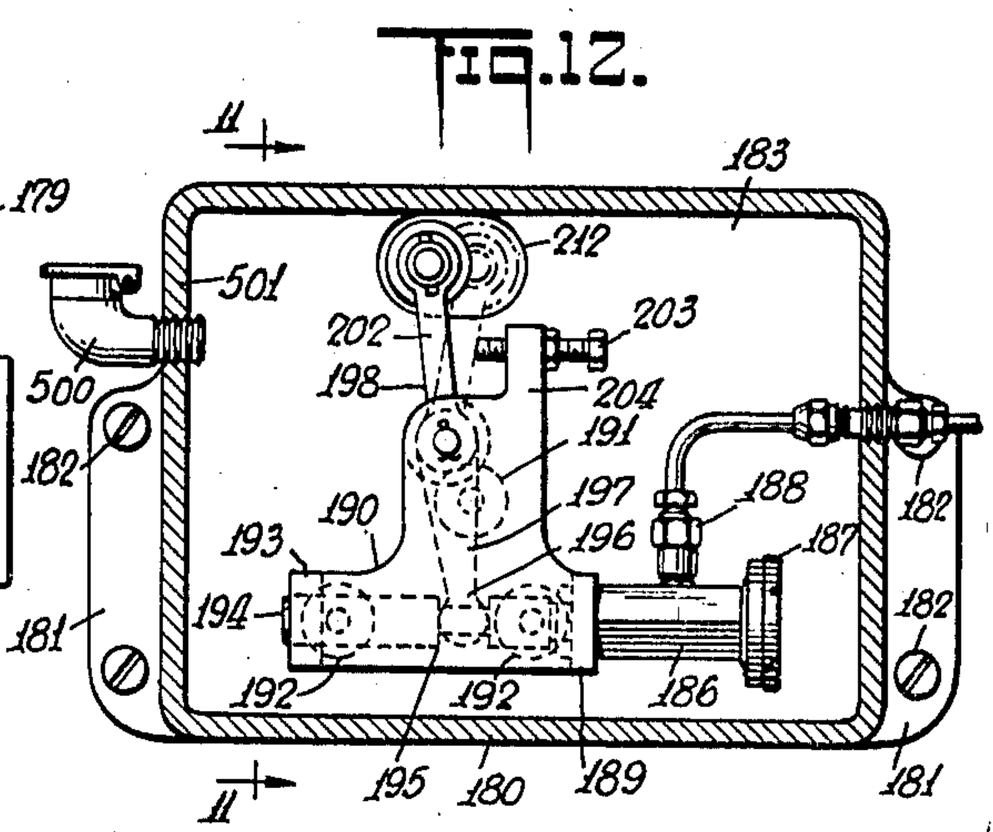


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FIG. 13.

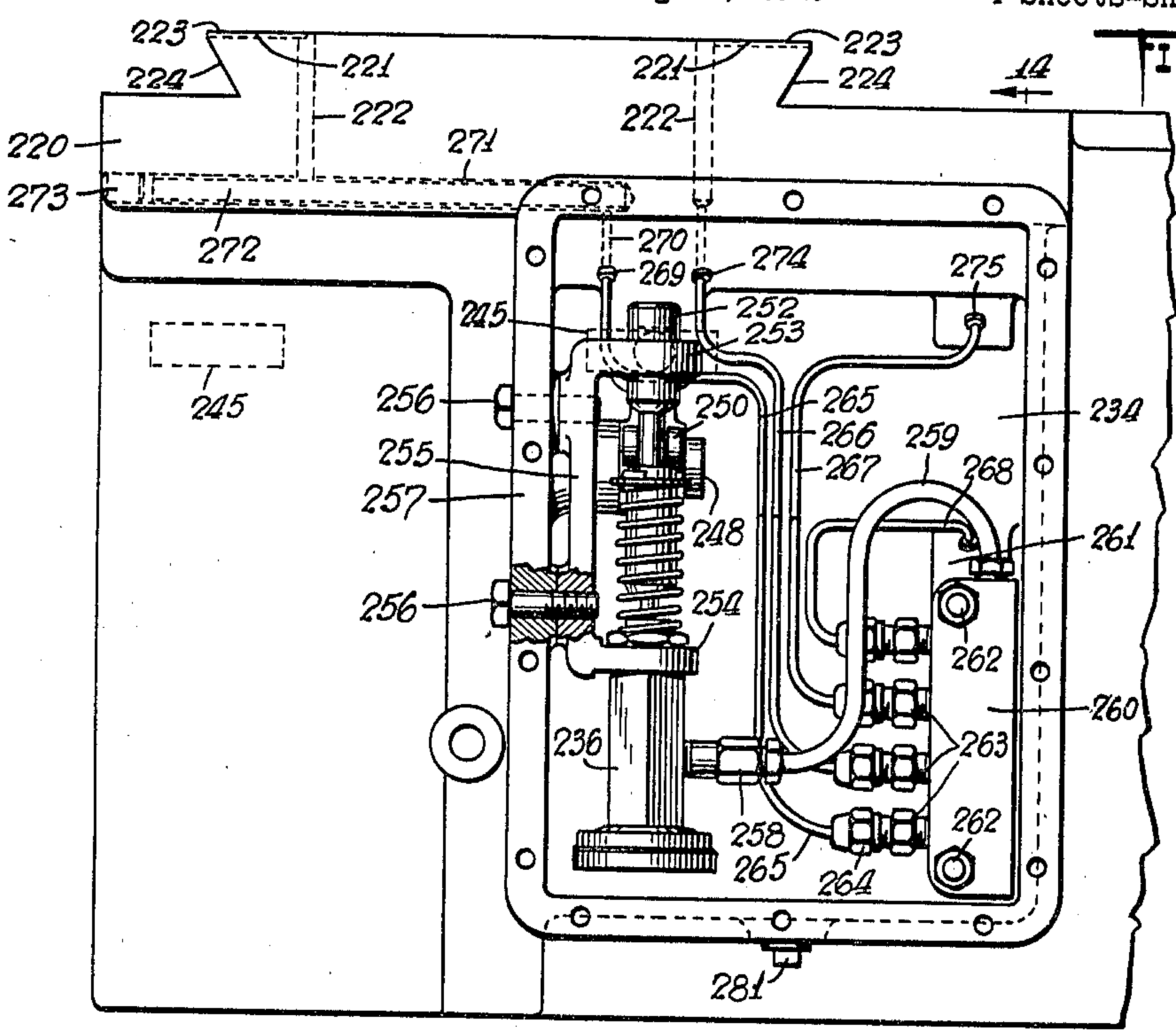
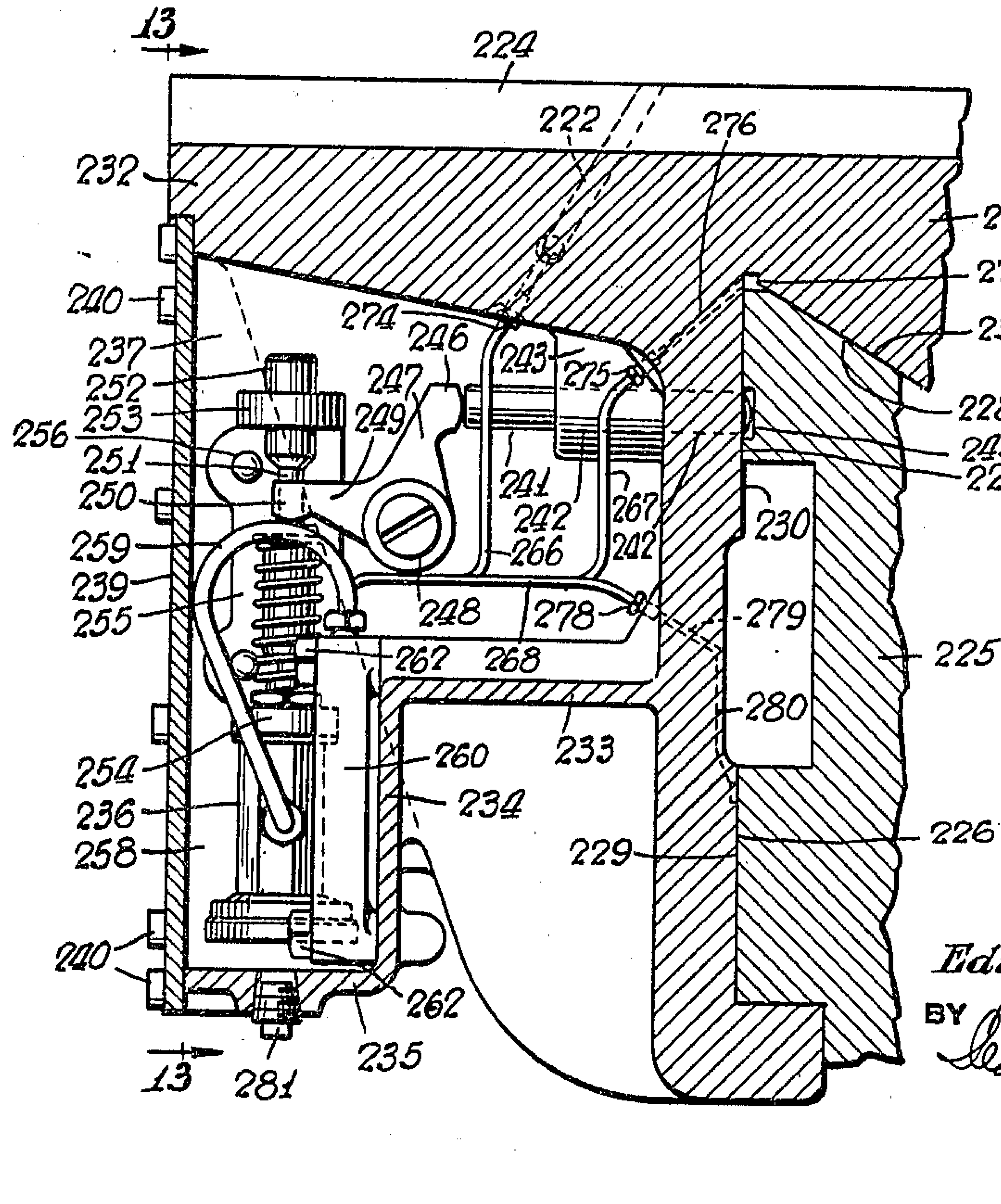


FIG. 14.



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LUBRICATION

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FIG. 15.

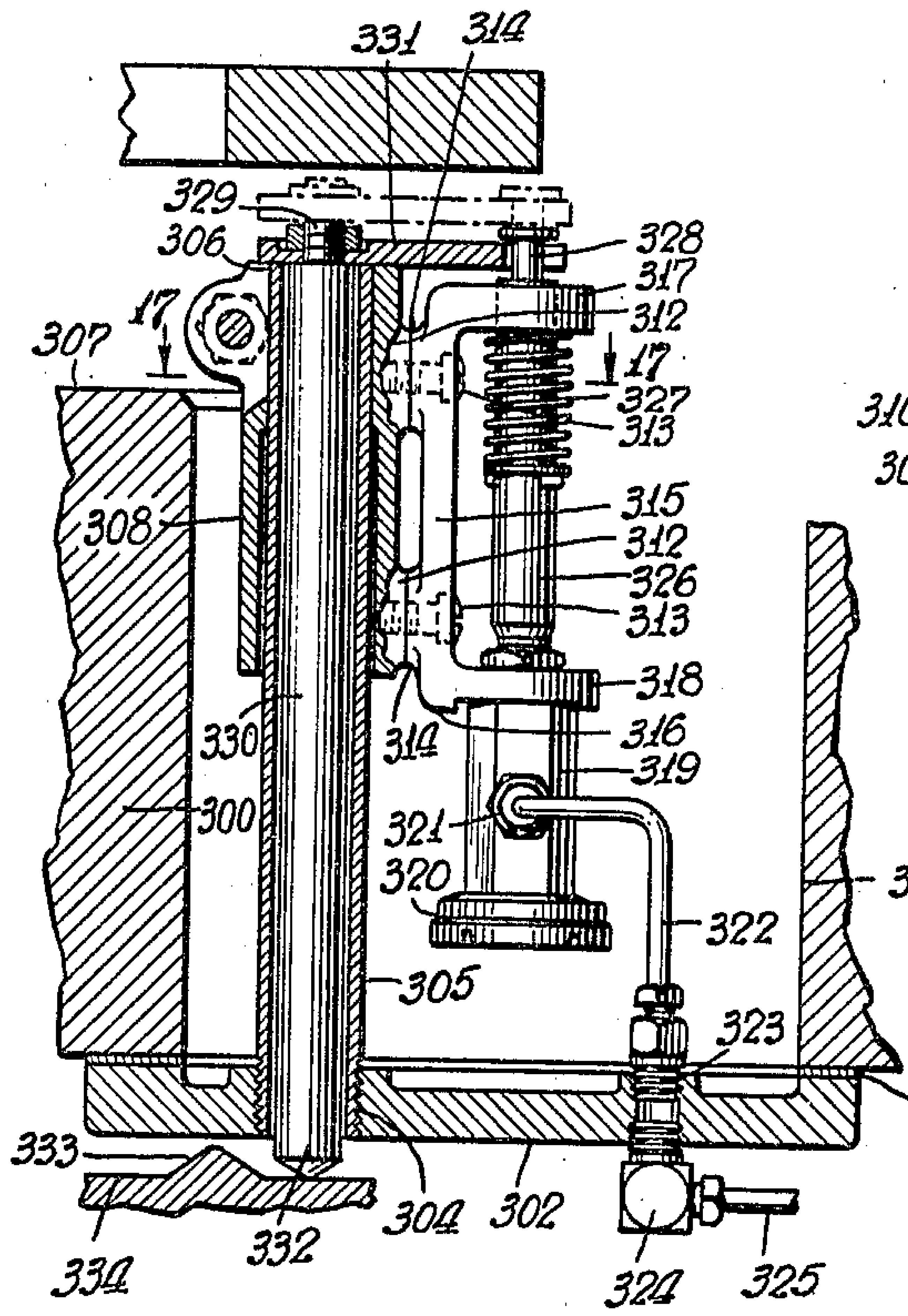


FIG. 16.

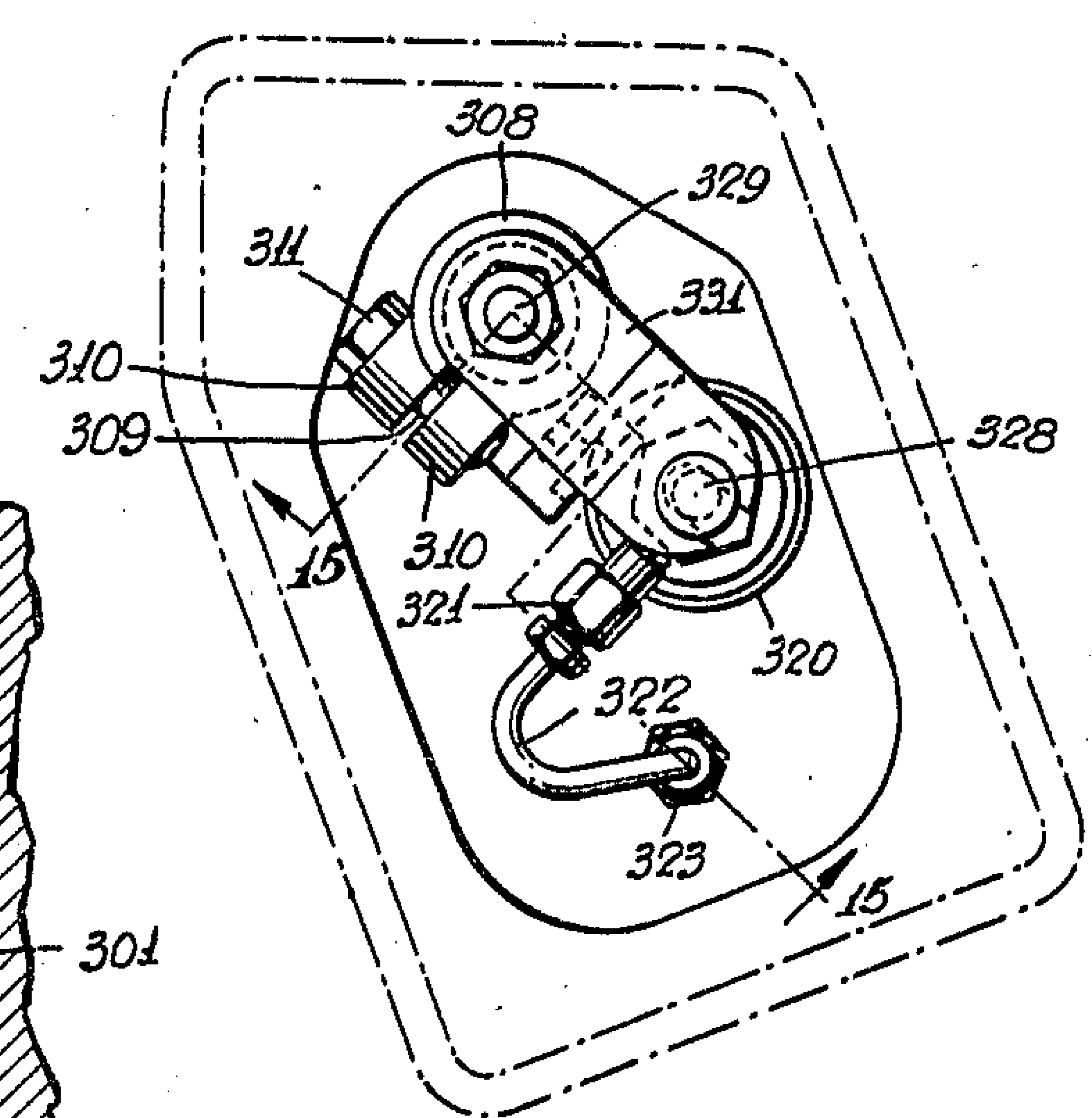


FIG. 17.

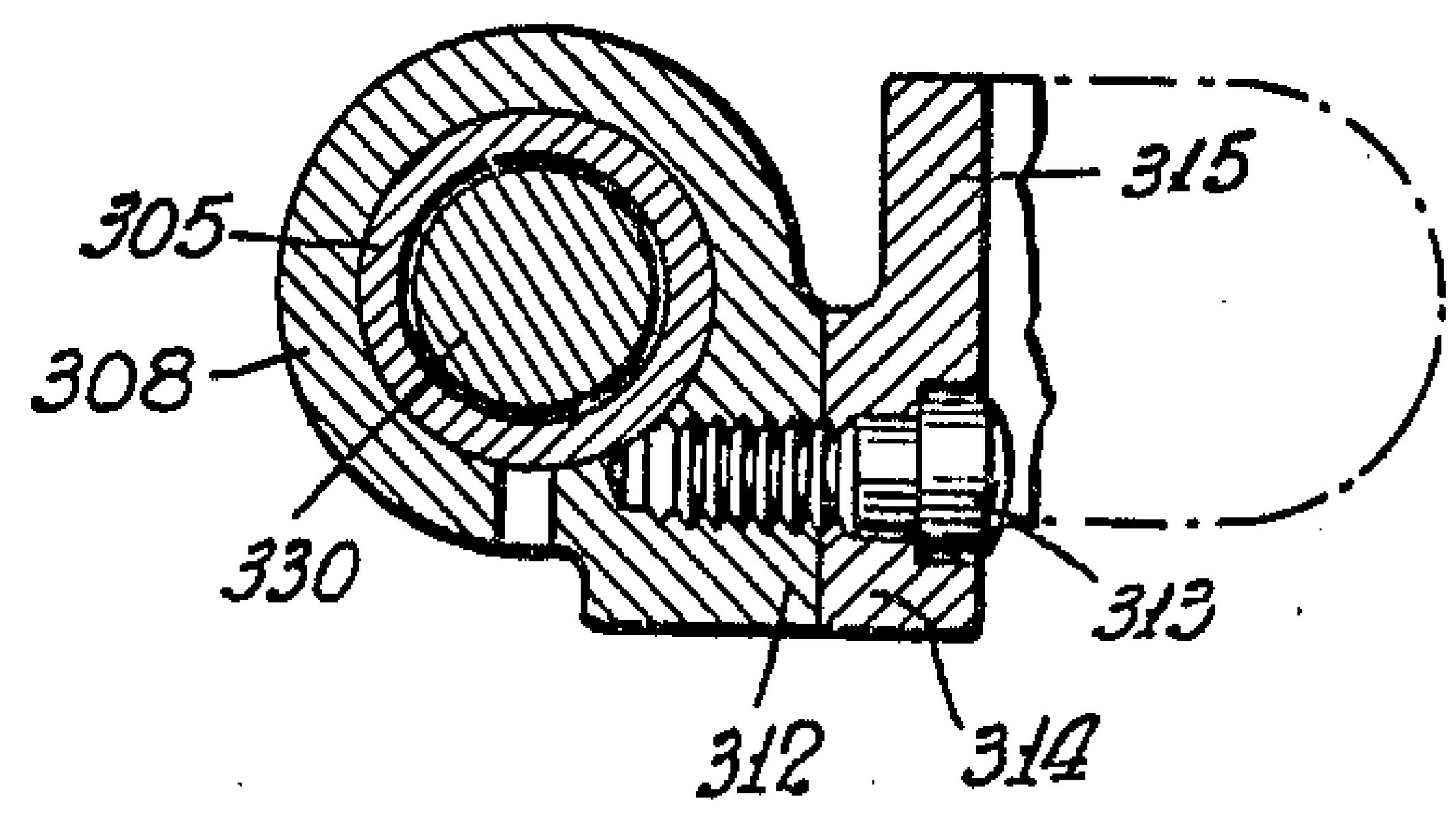
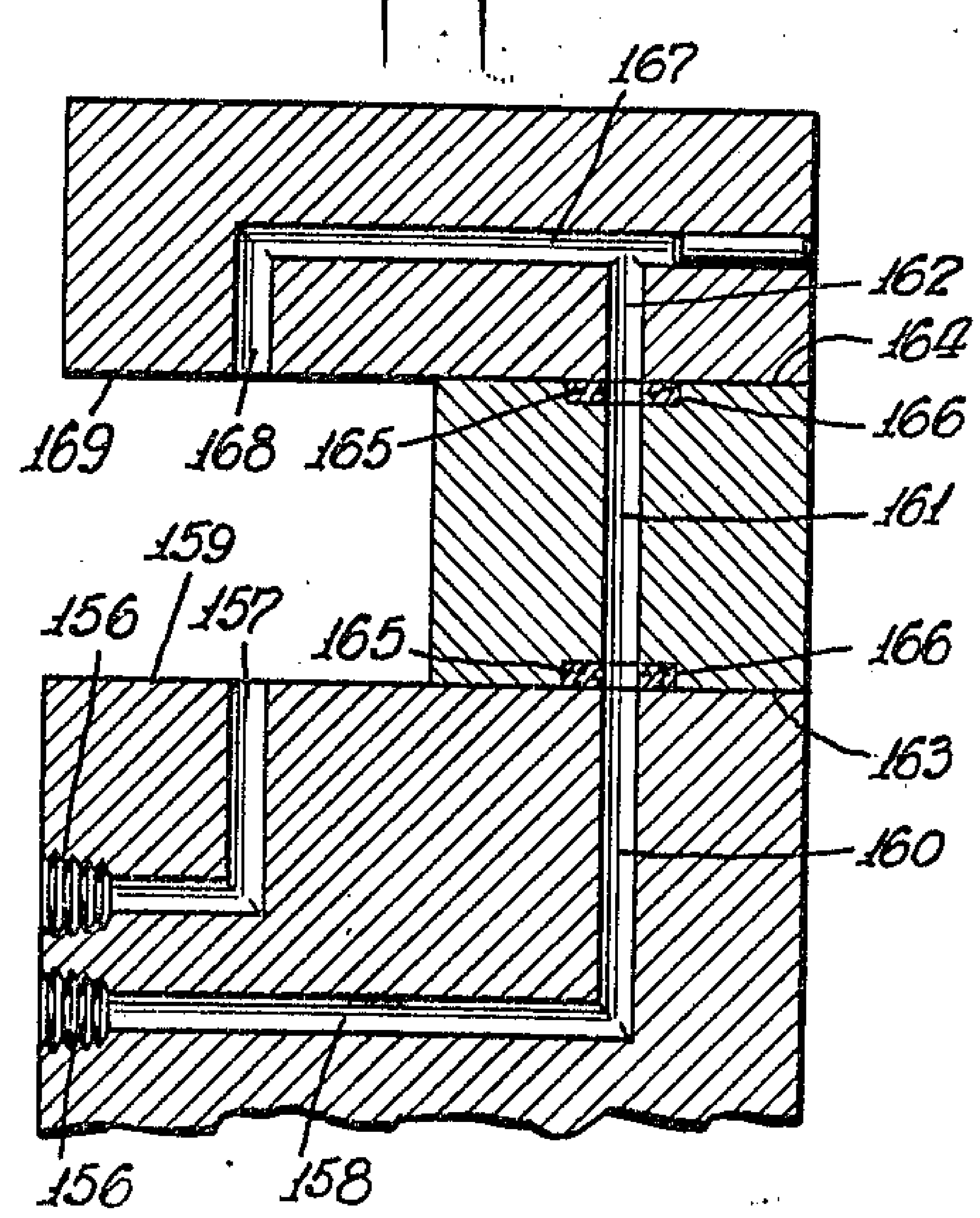


FIG. 9a



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Patented Mar. 7, 1944 2,343,302

UNITED STATES PATENT OFFICE

2,343,302

LUBRICATION

Edward H. Kocher, Boonton, N. J., assignor to Auto Research Corporation, a corporation of Delaware

Application August 3, 1940, Serial No. 350,650

7 Claims. (Cl. 184—6)

The present invention relates to machine tools, and it particularly relates to lubricated machine tool constructions.

Although not specifically restricted thereto, the present invention will be described in connection with its application to the lubrication of surface grinding machines and to other machine tools having reciprocating or moving tables.

It is among the objects of the present invention to provide an improved lubricated machine tool construction which will be lubricated reliably and automatically in accordance with the exact quantity of lubricant required by each bearing and determined by the timing size, speed and mode of operation of the machine.

Another object of the present invention is to provide improved lubricated horizontal hydraulic broaching machines and horizontal boring, drilling and milling machines, and it particularly relates to the provision of lubricated slide mechanisms for these machines as well as for various turret and cross carriages of turret lathes.

Still further objects and advantages will appear in the more detailed description set forth below, it being understood, however, that this more detailed description is given by way of illustration and explanation only and not by way of limitation, since various changes therein may be made by those skilled in the art without departing from the scope and spirit of the present invention.

In accomplishing the above objects, it has been found most suitable according to one embodiment of the present invention to provide either a reciprocating unpacked elongated plunger pump which is positioned in a casing or recess on or about the mechanism to be lubricated which will be provided with an actuating member to cause reciprocation of the plunger thereof in accordance with the number of reciprocations or the amount of travel of a carriage sliding member or other reciprocating mechanism.

In the preferred construction, this pump has a single outlet and is connected to a branched distributing tubing and bore system which feeds a plurality of bearings distributed over and around the machine tool mechanism and particularly the ways and slide bearings of the machine tool mechanism with accurately proportioned, yet relatively minute quantities of lubricant in accordance with the needs of the bearings.

In the drawings which show one or more of the various possible embodiments which may be constructed according to the present invention, but to which the invention should not be restricted, since this embodiment is merely illustrative,

Figs. 1 and 2 are respectively end and side elevations partly in section, of a horizontal broaching machine to which the lubricating installation of the present invention may be applied;

Fig. 3 is a diagrammatic transverse sectional view upon the line 3—3 of Fig. 1 and upon an enlarged scale, illustrating the association of the reciprocating elongated plunger pump of the present invention with such a hydraulic broaching machine;

Fig. 4 is a transverse longitudinal sectional view upon an enlarged scale as compared to Fig. 3 of the pump assembly of Fig. 3;

Fig. 5 is a diagrammatic plan view of the lubricating installation supplied by the pump unit of Figs. 3 and 4, and, in turn, supplying the bearings to be lubricated of the broaching machine of Figs. 1 and 2;

Figs. 6 and 7 are longitudinal sectional views of flow metering restriction units which may be utilized in connection with the installation of Fig. 5;

Fig. 8 diagrammatically illustrates in side plan view, a double pump lubricating installation;

Figs. 9 and 10 are diagrammatic plan views illustrating an alternative lubricating installation; Fig. 9 illustrating the pump and reservoir construction on a section upon the line 9—9 of Fig. 10; and Fig. 10 illustrating the construction in a section upon the line 10—10 of Fig. 9;

Fig. 9*a* is an enlarged sectional view illustrating the application of the lubricating installation of Figs. 8 to 10 to a way structure;

Figs. 11 and 12 illustrate an alternative construction of pump and reservoir combination; Fig. 11 being a side sectional view upon the line 11—11 of Fig. 12; and Fig. 12 being a transverse sectional view upon the line 12—12 of Fig. 11;

Figs. 13 and 14 illustrate still another pump and reservoir combination, together with the lubricating installation as applied to a lathe carriage; Fig. 13 being a transverse sectional view upon the line 13—13 of Fig. 14; and Fig. 14 being a transverse sectional view upon the line 14—14 of Fig. 13;

Figs. 15 to 17 illustrate still another combination; Fig. 15 being a transverse sectional view upon the line 15—15 of Fig. 16; Fig. 16 being a plan view and Fig. 17 being a transverse sectional view upon the line 17—17 of Fig. 15.

Referring particularly to Figs. 1 and 2, there is shown a horizontal hydraulic broaching machine which is provided with a bed 10 serving as a rigid support for the entire mechanism and which contains separate reservoirs 11 and 12 for the hydraulic oil and the cooling agent.

The motor 13 is connected to the hydraulic pumping unit 14 by the flexible coupling 15.

The hydraulic pumping unit 14 is positioned on the outside of the baffle 16 and it is continuously submerged in the oil 11 in the hydraulic oil reservoir. The regulator 17 permits variation of the cutting speed, and it is provided with a suitable dial.

The hydraulic cylinder 18 is secured to the base 10 below the operating slide 19, and it is provided with a piston member 20 having the elongated connecting rod 21 passing through a stuffing box arrangement 22 at the inside end of the cylinder. The other end of the cylinder at 23 is blocked off by a cap. The slide will reciprocate upon the hardened steel ways 24.

There is also provided a lever 30 which enables control of the slide movement, a pulling head 31 having vertical adjustment, and a centrifugal pump 32 fitting alongside of the cooling liquid reservoir 12 is fed through the screen 33 which will remove any chip and scales therefrom. The cooling liquid after passing over the work, passes back through the chute 34 in the end plate 35. The chip compartment 36 opens on the side of the machine normally away from the operator.

The broaching machine as thus described in Figs. 1 and 2 may have a hydraulic cylinder diameter varying from 5 to 8½ inches, a stroke varying from 36 to 60 inches, a cutting slide speed of 10 to 28 feet per minute, a return slide speed of about 40 to 45 feet per minute, and it is desired that the ways 24 be lubricated in proportion to the number of reciprocations of the slide 19.

The slide 19 (see Fig. 3) is provided with a reservoir 25 which receives the pump 26 and carries the actuator 27 which is operated by the depressed cam portion 28 on the cover 29 upon reciprocation of the slide, and it is to this construction that the present invention is most particularly directed.

It will be noted in Fig. 5 that the pump unit 26 supplies lubricant to the conduit 37 which leads to the junction 38. The junction 38 has outlet conduits 39, 40, 41 and 42 respectively to the high restriction flow metering fittings 43, 44, 45 and 46, positioned so as to assure distribution of the lubricant over the ways to be lubricated.

The sliding actuator member 27 which fits in the bore 47 in the top wall 49 of the slide 19 above the reservoir 25, has a stop collar 50 which is normally pressed upwardly by the contact face 51 of the lever 52 pivotally mounted at 53 on the ears 54 of the bracket 55.

The bracket 55 is provided with the legs 56, 57, 58 and 59 and the base 60. The legs 56 and the base 60 are bolted to the downwardly projecting portions 61 and 62 of the structure 19.

The other end of the lever 52 is provided with a clevis 63 which fits on the rod 64, forming part of the connecting rod 65 (see Fig. 4). The connecting rod 65 carries the nut 66 against which reacts the coil spring 67 which encircles the connecting rod 65.

The end of the connecting rod 65 has a recess 68 which receives the coil spring 69. The spring 69 reacts against the mushroom head 70 of the elongated unpacked piston plunger 71, which fits in the bore 72 in the pump body 73.

The pump body 73 has a reduced end portion 74 which fits through the opening 75 in the leg 59 and is bolted down by the nut 76.

It is noted that the motion of the connecting rod 65 is limited by contact of the nut 66 against the end face 77 of the extension 74 of the pump body 73. The end of the pump body 73 carries the sheet metal cup 78, the base of which carries the screen 79 against which presses the felt filter pad 80 held in position by the rings 81 and 82.

In the end of the pump body 73 is a tapped recess 83, receiving the ball check body 84 having the ball check 85 held against the valve seat 86 by the spring 87 which reacts against the nipple member 88. The side of the pump body 73 is provided with a tapped recess 89, into which screws the body 90 of the outlet ball check having a valve seat member 91, a ball check 92 and a seating spring 93.

The body 90 constitutes the single inlet of the distributing system of Fig. 5 and connects with the tubing 37.

The fittings at 43 to 45 may be of the construction shown in either Figs. 6 or 7, with bodies 94 and 95 having central bores 96 and 97 and closely fitting restriction pins 98 and 99.

In Fig 6, the pipe threaded portion 100 is designed to be screwed into an outlet junction or machine part, while in Fig. 7 the pipe threaded end portion 101 is designed to receive lubricant from a junction fitting or from a bore in a mechanism.

The nipples 102 and 103 and the pipe threaded end portions 104 and 105 are designed to be attached to compression coupling nuts.

Each of the fittings of Figs. 6 and 7 is provided at one end with the cup shaped screen 106, which receives the strainer plug 107 and at the other end with the check valve 108, which is seated by the spring 109.

In operation, as the broach slide 19 travels to the limit of its stroke and returns, the depression 28 will operate twice upon the actuator member 27, causing the pump to undergo two discharge strokes which will create a substantially continuous lubricant pressure in the distributing system of Fig. 5, supplying the correct amount of oil to each bearing surface.

Although in the construction shown there are only four outlet branches 39 to 42, it is of course obvious that an additional number of outlets might be provided, depending upon the size of the broaching machine.

Desirably, drilled holes are provided in the sliding member to conduct the oil from the metering units of Figs. 6 and 7 to the broachways, and the bottom way is lubricated chiefly by drainage from upper bearing surfaces.

The check valves 108 in the metering units prevent dripping and maintain the system full of oil so that there is no dripping of oil, nor any lag in lubrication once the machine is started.

In the construction of Fig. 8, there is illustrated a horizontal surface broach double pump lubricating installation with a slide 120 moving on the bed 121 which is provided with two reservoirs 122 and two pumps 123 of the construction already described in connection with Figs. 3 and 4.

Each of the pumps is provided with a lever assembly 124 having a roller follower 125 which is operated by the dog member 126 upon the bottom surface of the slide 120. As the slide 120 moves the full length of the bed 121, it will first operate one pump and then the other, with the result that each of the pumps will discharge

lubricant on each reciprocation. The pumps may have diameter pistons varying from $\frac{3}{16}$ to $\frac{7}{16}$ of an inch, and may have strokes varying from $\frac{1}{4}$ to $\frac{3}{4}$ of an inch.

Details of the lubricating installation shown diagrammatically in Fig. 8, are shown in Figs. 9 and 10. Each pump is positioned horizontally in the corresponding reservoir 122 which has the end closure 145 upon which the base of the corresponding pump bracket 127 is supported. The base 126 is provided with the outstanding legs 128 and 129. The leg 128 forms a bearing for the connecting rod element 130. The rod 130 has the reduced diameter portion 132 which is embraced by the clevis 133 of the lever 134.

The lever 134 is provided with an eye 135 (see Fig. 9), which is fixed by the pin 136 upon the shaft 137 which extend through the plate 145 and the boss 138 thereof. The other lever 139 of the lever assemblage 124 is also provided with an eye member 140 fitting on the other end of the shaft 137 and fixed thereon by the pin 141. Lever 139 carries the roller member 125 which is operated by the dog member 126.

The outlet check valve member 146 has an outlet tubing 147 which extends through the adapter 148 in the side wall 149 of the reservoir 124 and is connected to the external tubing 150.

The tubing 150 leads to the junction 151 which, in turn, has lines 152 leading to the junction 153. Each junction 153 feeds two pairs of metering units 154 through the corresponding end of the piping 155. As shown in Fig. 9*a*, each of two associated metering units 154 may feed sockets 156 which, in turn, are connected to internal bore systems 157 and 158. The bore system 157 feeds the face 159, whereas the bore system 158 has the bores 160, 161 and 162 extending across the faces 163 and 164, the cross-overs being sealed by the compressible washers 165 compressed into the recesses 166. The bore 162 feeds the bores 167 and 168. The latter bore 168 opens onto the face 169.

In Figs. 11 and 12, is shown a unit useful on an automatic lathe construction. The oil reservoir 180 is provided with a cover 179 and a side flange 181 which receive the bolts 182 enabling the reservoir to be bolted to the side wall of the lathe or the side wall of an apron or lathe carriage. It may be filled through the filler tube 500 in the wall 501.

The pump 186 has the inlet filter 187 and the outlet check valve unit 188 and may be of the same construction as already described in connection with Figs. 3 and 4.

This pump is supported by the cross member 189 of the bracket 190, which is fixed by the screws at 191 and 192 to the wall or plate 183.

The cross member 193 serves as a bearing for the connecting rod 194. The connecting rod 194 has a recessed portion 195 receiving the clevis member 196 of the arm 197 of the lever 198.

As best shown in Fig. 11, the lever 198 has a central sleeve 199 which fits on the shaft 200, extending between the side walls 184 of the bracket.

The sleeve 199 has the outstanding arm 202, the movement of which is limited by an adjustable stop 203 carried by the lug 204 of the bracket 190. The arm 202 carries the rod 205 which extends through the opening or slot 212 in the wall 183, and which has a cup-shaped head 207 at its outer end capped by a friction member 211 and pressed in the direction 208 against the carriage face 209 by a spring 206 that encircles the rod.

Upon relative movement of the carriage 209 on slideway 210, the lever 198 will be reciprocated, causing one discharge of the pump 186 upon each complete reciprocation.

The pump just described is particularly suitable where it is desired to obtain one complete pump stroke for each longitudinal motion of the carriage 209, whether this carriage moves through either a long or short stroke, and if there is an excess movement beyond that necessary to operate the piston, there will be just a sliding friction between contact elements 209 and 211, which will not be effective to cause further charge or discharge of the lubricating pump.

In the construction shown in Figs. 13 and 14, the lathe carriage or other machine tool body is provided with the cross slide ways 221 having the oil grooves 223 and the bores 222 feeding the same, and the oblique side faces 224.

The carriage 220 is designed to slide upon the structure 225 having the vertical contact faces 226 and 227, and the inclined face 228, which contact in turn the faces 229, 230 and 231 of the carriage 220.

The sliding structure 220 has a ledge portion 232 and an outstanding wall member 233 having the downwardly extending portion 234 and the forwardly extending portion 235. The members 234 and 235 form a recess for receiving the pump 236 which may be of the construction shown in Fig. 4. The recess 237 which receives the pump 236 may be covered by the front plate 239 held in position by the bolts 240. The base of U-shaped bracket 255 is connected by the bolts 256 as shown best in Fig. 3 to the side wall 257 of the recess 237. The pump 236 is carried by the leg 254 of the U-shaped bracket 255 and the rod 252 has a bearing in the leg 253. As the structure 220 reciprocates the horizontal slider member 241, which fits in a bore 242 in the boss 243, will be cammed out as it is moved past recess 245 in the face 227. The arm 249 of the bell crank lever is provided with a clevis jaw 250 which fits on the reduced diameter portion 251 of the connecting rod 252. Slider 241 thus pushes arm 247 of bell crank lever 248 to operate pump 236.

The outlet check valve 258 feeds lubricant under pressure into a relatively large diameter tube 259 which leads to the junction 260 on the other side wall 261 of the recess 237.

The junction 260 is held on the side portion 261 by the bolts 262. Connected to the junction are the metering fittings 263 of the construction shown in Fig. 7, which have the outlet coupling nuts 264 and feed the tubes 265, 266, 267 and 268.

As best shown in Fig. 13, the tube 265 connects at 269 to a bore 270 which in turn leads to a bore 271 largely filled by the filler member 272 to reduce the volume thereof and plugged at 273. From the bore 271, the lubricant feeds one of the upright oblique bores 222 (see also Fig. 14).

The tube 266 connects at 274 to the internal bore system which terminates in the other oblique bore 222 feeding the other side of the structure at 221.

The tube 267 (see Fig. 14) connects at 275 to the bore 276 feeding the opening or recess 277, from which the lubricant flows down over the contacting faces 227 and 230.

The tubing 268 connects at 278 to the internal bore 279, which feeds a groove 280 conducting lubricant to the contacting faces 226 and 229.

Desirably, the recesses 245 may be spaced apart three or four inches. As the reciprocating member 241 slides in and out of said recesses 245, the pump 236 will be caused to reciprocate, feeding lubricant to the various bearings of the lathe which are to be lubricated.

In the preferred construction, the structure 220 constitutes the apron of the carriage of a lathe with the structure 225 constituting the bed of such lathe. The reservoir, if desired, may be drained at intervals through the cleaning plug 281.

In Figs. 15 to 17, is shown a lubricating installation which may be employed in connection with a rotary or reciprocating grinder. In the body 300 of the machine there is a recess 301 which may be closed by the bottom plate 302 and the gasket 303.

The bottom plate 302 is provided with a tapped opening 304, from which the tube 305 extends upwardly to a point 306 substantially above the top face 307 of the body 300.

Around the tube 305 is positioned the sleeve 308, which is split at 309 and is provided with the jaws 310 which are drawn together with the bolt 311. The side of the split sleeve 308 is provided with the boss 312 (see Fig. 17) against which is bolted by bolt 313 the pads 314 of the base 315 of the bracket 316. The bracket 316 has the outstanding legs 317 and 318.

The lower leg 318 carries the pump body 319 having inlet strainer cup 320 and the outlet ball check 321. The outlet tube 322 which extends to the lubricant-tight fitting 323 extending through the bottom plate 302 and connecting with the adapter 324 and external tubing system 325.

The connecting rod 326 is normally pressed downwardly by the spring 327, and it has a bearing in the upper leg 317 of the bracket 316.

The upper end of the connecting rod 328, together with the upper end 329 of the reciprocating vertical actuating member 330, are connected by the plate 331 which may reciprocate from the lower solid line position as shown in 331, in Fig. 15, to the upper dotted line position.

The lower end 332 of the reciprocating member 330 is designed to strike the dogs 333 on the rotary table 334 of the grinder, to cause reciprocation and discharge of the pump 319 through the outlet tube 322.

The installation as shown in Figs. 15 to 17 is particularly suitable for use upon a surface grinder may by way of example be utilized to feed four metering units of the type shown in Figs. 6 and 7, which, in turn, lubricate the horizontal ways of the machine.

In the preferred application, the machine has a substantially fixed head which rotates a vertical spindle, and there is mounted on the bottom of the spindle, a cup grinding wheel. The parts to be ground are placed on a horizontal table which is alternately moved under and away from the wheel.

In all the constructions shown, assurance is had of an automatic substantially continuous lubrication of the mechanism to be lubricated throughout operation of the particular machine tool.

It will be understood that many changes could be made in the particular features of the mechanism as shown, and many apparently widely different embodiments of this invention could be made without departing from the scope thereof; it is intended that all matter contained in the above description shall be interpreted as illustrative and not in a limiting sense.

What is claimed is:

1. In a horizontal hydraulic broaching machine having a bed, an operating slide reciprocating on said bed having parallel elongated longitudinal slide bearings to be lubricated, said slide having a recess forming a reservoir and a reciprocatory actuator member projecting vertically past the upper part of said slide, two legs projecting downwardly alongside of said pusher member from said upper part of the slide, an inverted U-shaped bracket with its base mounted on the lower ends of the legs, a horizontally disposed spring returned, reciprocating plunger pump, with an angle lever pivotally mounted on said bracket actuated by said actuator member to actuate said pump, said bed carrying a cover having a downwardly extending cam-like boss to reciprocate said actuator member on each reciprocation of said slide.

2. In a lubricated machine tool, a relatively moving carriage and a relatively fixed frame, having bearing slides along which said carriage moves, one of said elements being provided with a lubricant receiving recess, a bracket affixed to a wall of said recess, a reciprocating pump in said recess and carried by said bracket, an actuator for said pump protruding from said machine tool element, a transmission from said actuator to said pump and carried by said tool element, and means upon the other element of the tool riding over the protruding part of said actuator and operating the pump in the course of the relative sliding movement of the carriage and the fixed frame.

3. The combination recited in claim 2 in which the protruding actuator has a sliding fit in the machine tool element carrying the same and in which the other relatively moving machine tool element has a dog for operating said actuator.

4. In a lubricated machine tool, a relatively moving carriage and a relatively fixed frame, having bearing slides along which said carriage moves, one of said elements being provided with a lubricant receiving recess, a bracket affixed to a wall of said recess, a reciprocating pump in said recess and carried by said bracket, said pump having a connecting rod, said bracket forming a bearing for said connecting rod, an actuator for said connecting rod protruding from said element of the machine tool, and means upon the other element of the tool riding over the protruding part of said actuator and operating the pump in the course of the relative sliding movement of the carriage and fixed frame.

5. The combination recited in claim 4 in which the actuator is mounted for longitudinal movement in the machine tool element carrying the same, and in which a bell crank lever is pivoted to the pump carrying bracket with one arm thereof in the path of said actuator and in which the other arm has a clevis connection to said connecting rod.

6. In a lubricated machine tool, a relatively moving carriage, having a lubricant carrying recess in the interior thereof, a relatively fixed bed upon which said carriage moves, a fixed cover extending over the moving carriage and having a dog on the under surface thereof, a bracket mounted within said lubricant reservoir, a horizontal pump carried by said bracket and having a connecting rod guided thereby, a bell crank lever mounted on said bracket having an arm with a clevis coacting with said connecting rod

and a sliding actuator in the upper part of said moving carriage engaging the other arm of said bell crank lever and having a protruding end to be depressed by said dog as it is moved therepast in the reciprocation of said moving carriage.

7. In a lubricated machine tool, a relatively fixed bed, a relatively moving carriage mounted thereon, a lubricant carrying recess in the side of said carriage, a pump carrying bracket affixed to the wall of said recess, a reciprocating pump vertically mounted by said bracket, and having a connecting rod thereabove, a bell crank lever pivoted within said recess having a clevis on one arm coacting with said connecting rod, a horizontal sliding actuator in said moving carriage coacting with the other arm of said bell crank lever, and cam means on said fixed frame member for effecting movement of said actuator and operation of said pump as the actuator is moved past said cam in the operation of the machine.

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