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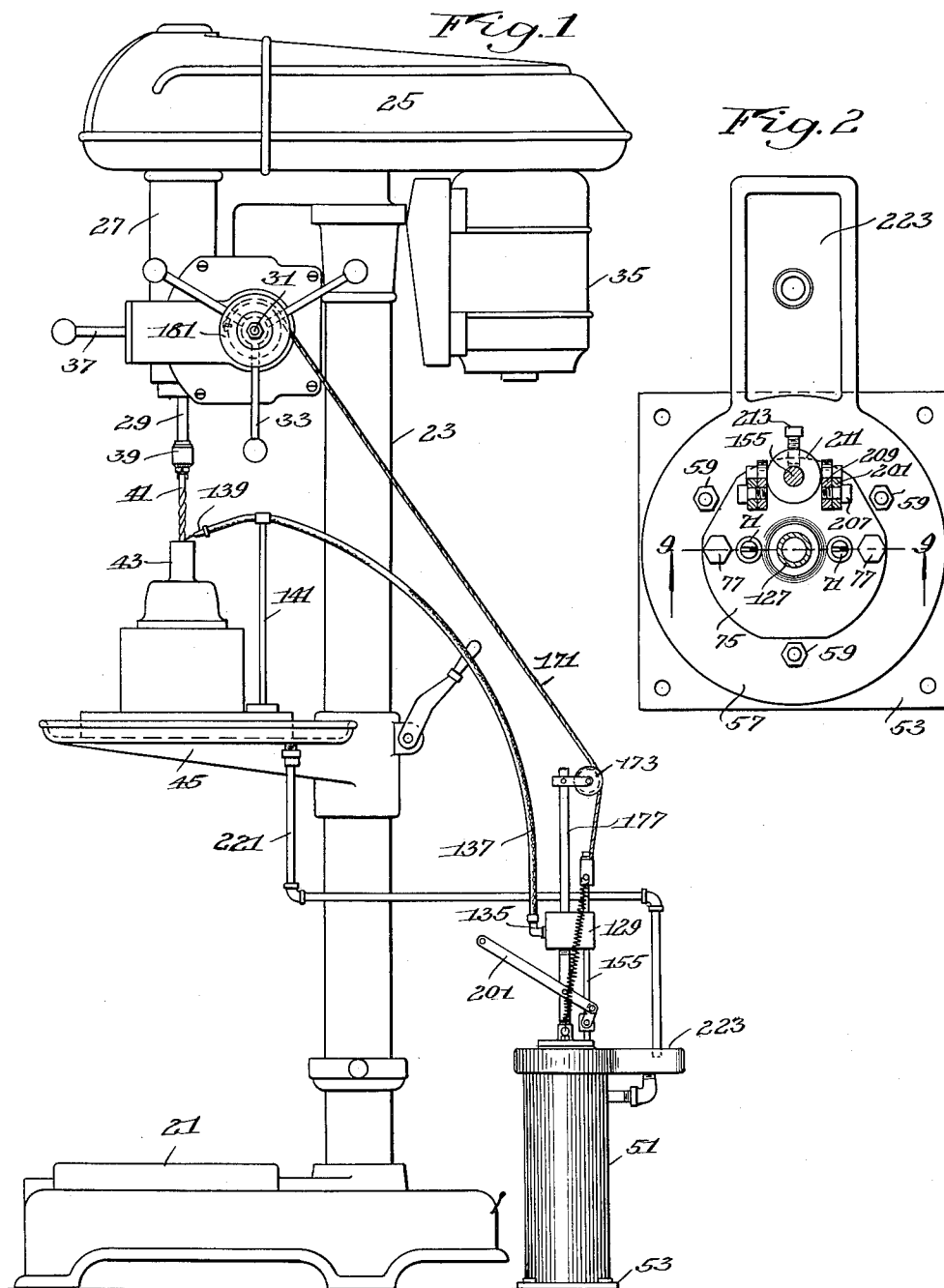
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COOLANT SUPPLYING MECHANISM FOR MACHINE TOOLS

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4 Sheets-Sheet 1



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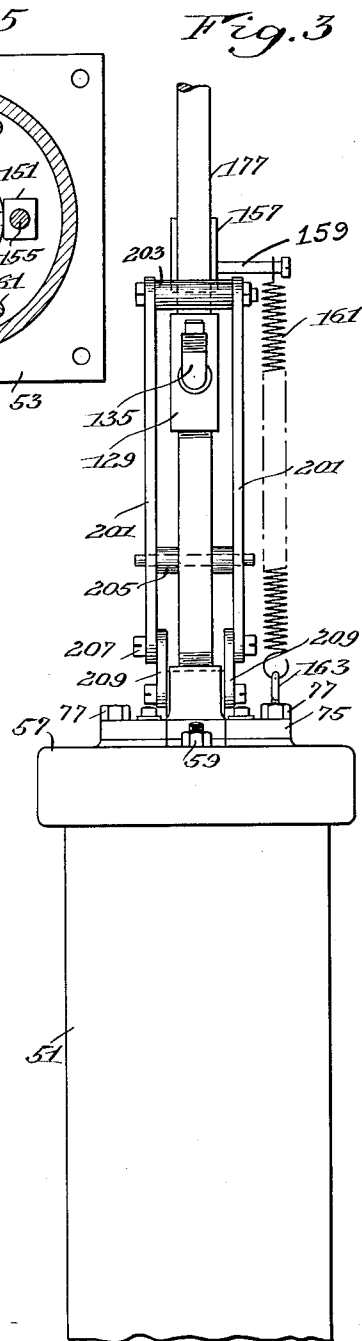
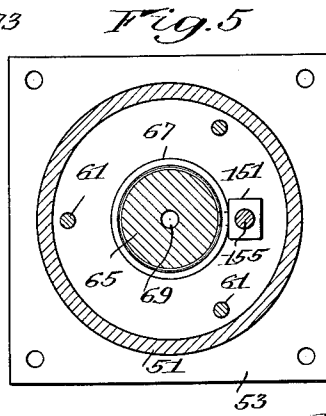
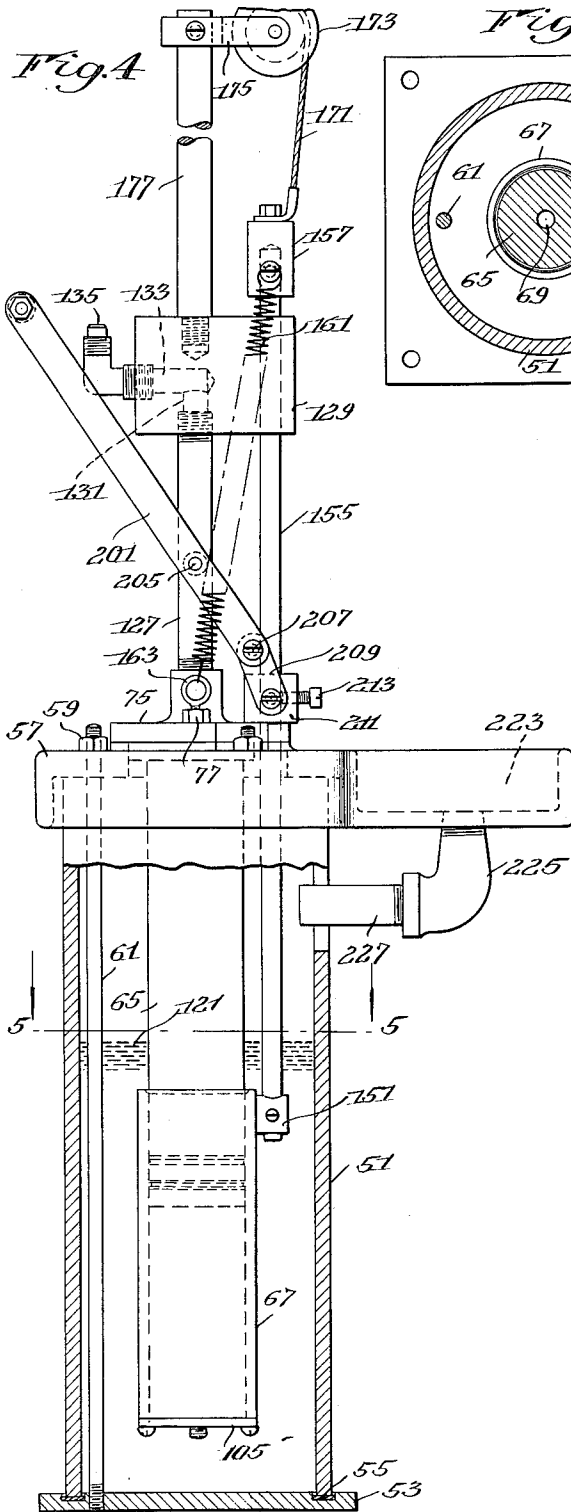
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4 Sheets-Sheet 2



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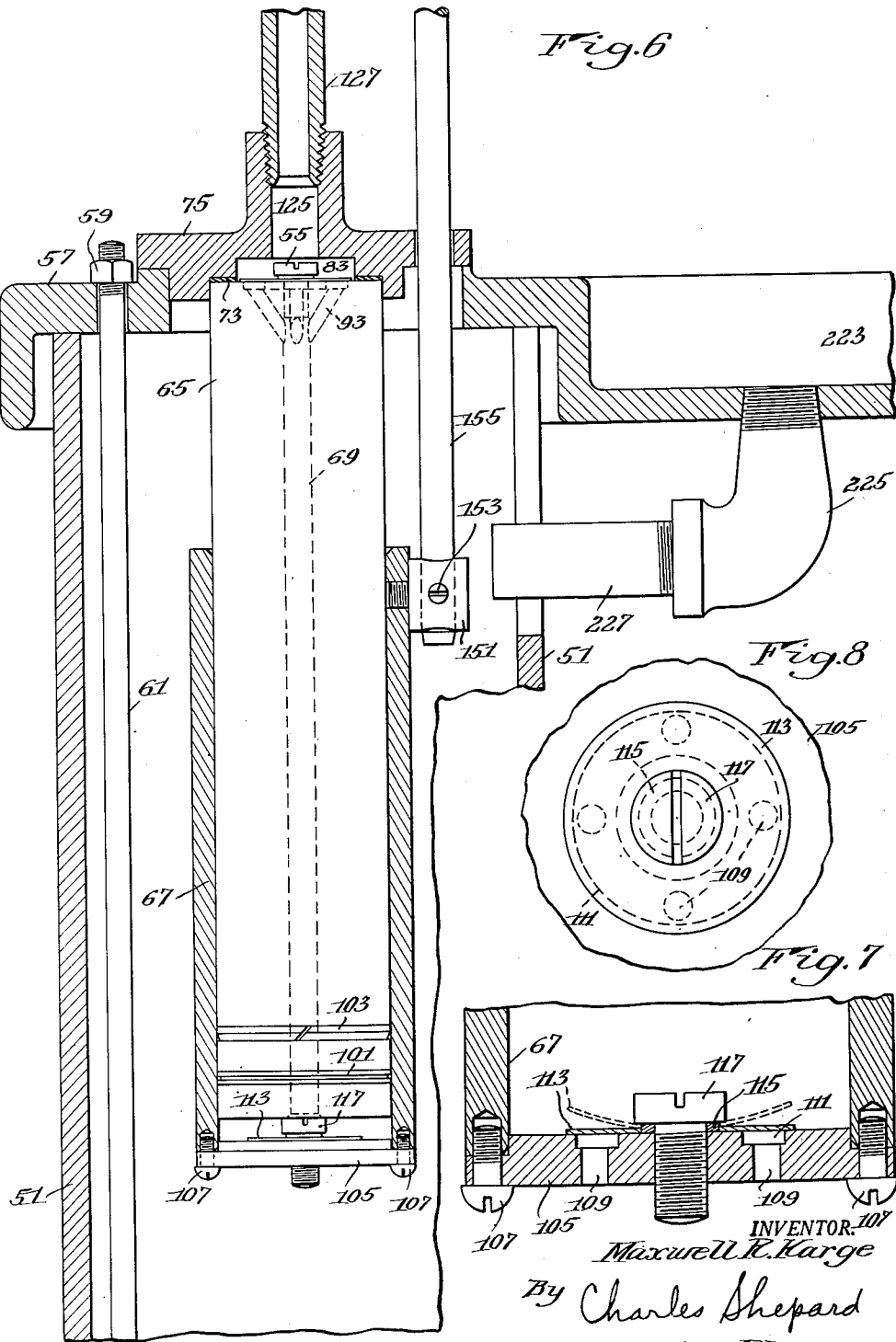
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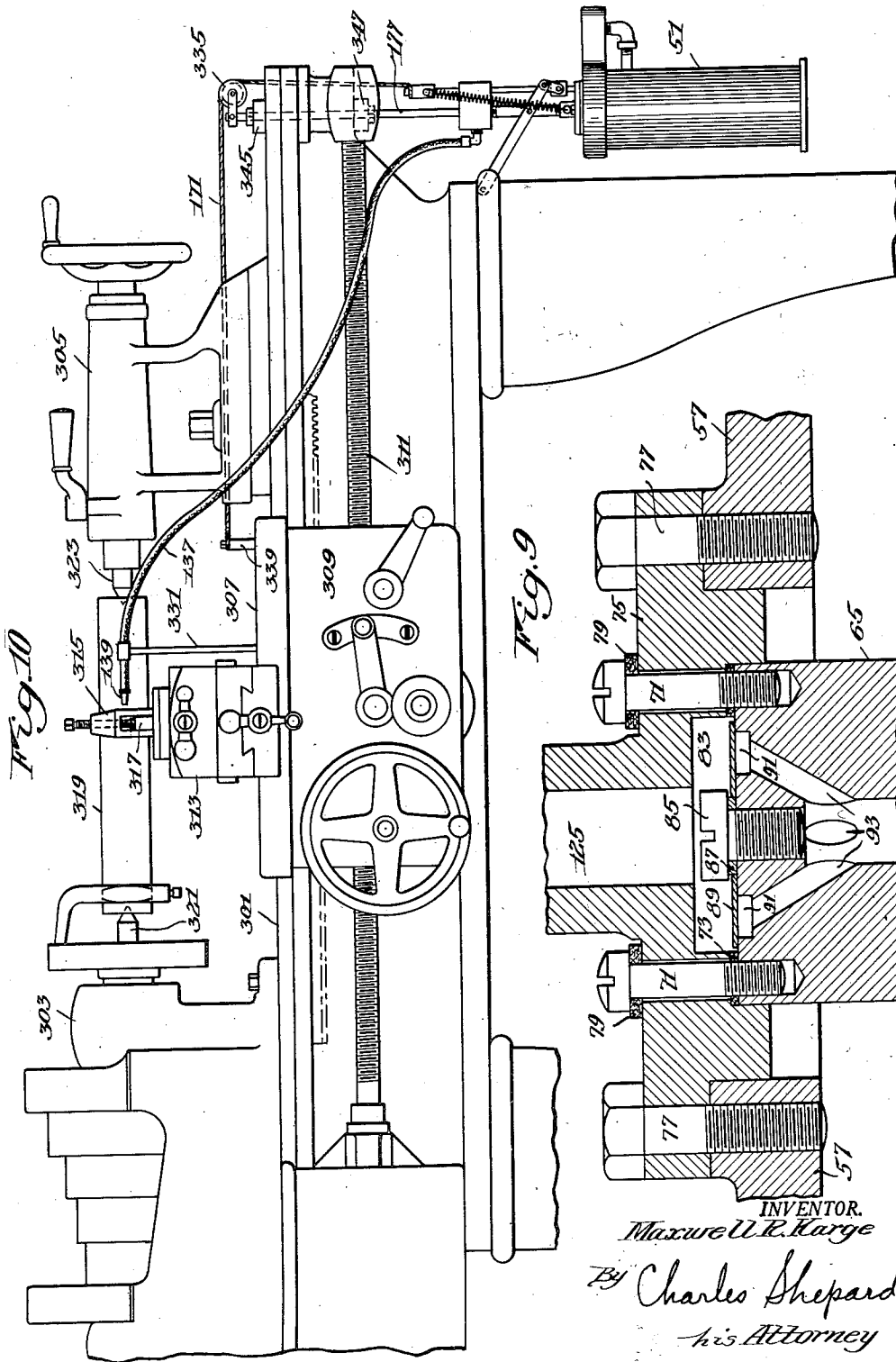
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UNITED STATES PATENT OFFICE

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COOLANT SUPPLYING MECHANISM FOR
MACHINE TOOLS

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7 Claims. (Cl. 77-55)

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This invention relates to means for supplying coolant to machine tools such as drill presses, lathes, milling machines, planers, and the like. An object of the invention is the provision of generally improved and more satisfactory mechanism of this character.

Another object is the provision of coolant supplying means of a compact nature, so designed and constructed as to be capable of easy attachment to existing machines.

Still another object is the provision of coolant supplying means operated by the feeding movement of the machine tool to which it is applied.

A further object is the provision of coolant supplying so constructed that coolant is supplied accurately and positively to the cutting tool, in synchronism with the feeding movement of the tool.

A still further object is the provision of coolant supplying mechanism of few parts, simple and easy to construct and to maintain, and of a rugged character not likely to get out of order.

These and other desirable objects are accomplished by the construction disclosed as an illustrative embodiment of the invention in the following description and in the accompanying drawings in which:

Fig. 1 is a side elevation of a preferred embodiment of the invention, illustrating it as applied to a drill press of otherwise conventional design;

Fig. 2 is a plan of the mechanism, with parts in horizontal section;

Fig. 3 is a front elevation of the coolant pumping mechanism;

Fig. 4 is a side elevation of the same, with parts broken away and parts in vertical section;

Fig. 5 is a horizontal section taken substantially on the line 5-5 of Fig. 4;

Fig. 6 is a vertical section taken centrally through the pump;

Fig. 7 is a vertical section through the lower end of the pump cylinder illustrating the construction of the inlet valve;

Fig. 8 is a plan of the valve shown in Fig. 7;

Fig. 9 is a vertical section through the upper part of the pump taken substantially on the line 9-9 of Fig. 2; and

Fig. 10 is an elevation of the coolant supplying mechanism as applied to a lathe of otherwise conventional construction.

The same reference numerals throughout the several views indicate the same parts.

Heretofore it has been the common practice to supply coolant (intending to include cutting oil within the scope of the work coolant) either by

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hand, as from an oil can, or by a motor driven pump which pumps the coolant continuously. Both of these practices are objectionable. The supply of coolant from a hand-held oil can occupies the time and attention of the operator, while the supply of coolant from a motor driven pump is usually at a constant rate irrespective of the feeding rate of the machine, so that too much coolant is supplied during slow feeding movements or too little during rapid feeding movements, unless a control valve is used. When a control valve is employed, there is the objection of having to adjust the valve when the rate of feeding changes, and also the coolant will continue to flow after the feeding movement has stopped, until the valve is turned off or the machine is shut off. There is the further objection that motor driven pumps are subject to considerable unnecessary wear by reason of their operation when the tool is not feeding, and the pumps or the driving mechanisms of the pumps are likely to get out of order and to require considerable maintenance.

All of these objections are overcome by the coolant supplying means of the present invention, which comprise a simple, rugged, and inexpensive force pump connected to the machine tool in such fashion as to be operated directly by the feeding movement itself, so that when the feeding movement stops the supply of coolant likewise stops, and the quantity of coolant automatically delivered is always proportional to the feeding movement. This improved mechanism has the further great advantage that it may be readily installed on existing machine tools which originally had no provision for any coolant pump.

Referring now to Fig. 1 of the drawings, there is illustrated merely by way of example a conventional drill press, the details of which are immaterial so far as the present invention is concerned. The drill press may comprise, for example, a base 21 from which rises a standard or column 23 carrying a head 25 provided with a spindle housing 27 in which a spindle 29 is vertically movable by rotating the spindle feeding shaft 31 as by means of the arms 33 attached thereto. The spindle is driven from an electric motor 35 mounted on the head 25. A control lever 37 starts or stops the rotation of the spindle 29 when the motor 35 is running. The lower end of the spindle 29 carries a chuck 39 in which is removably mounted the drill 41 or other suitable tool for operating upon the work, such for example as the work piece 43 mounted on the work table 45 which is adjustable on the column 23.

The above mentioned details of the drill press are for the sake of example only, and may be varied at will without departing from the invention.

The coolant supplying means of the present invention comprises a pump connected to the drill spindle feeding shaft 31 so that the pump is operated by and in accordance with the feeding movements of the spindle 29. This pump in its preferred form includes a main cylindrical member 51 mounted in a liquid-tight manner on a base plate 53 (Fig. 4) so as to form a main reservoir for the coolant. Conveniently this is done by setting the lower end of the cylinder 51 in an annular groove in the top face of the plate 53, abutting against an interposed gasket 55. A top member 57 covers the upper end of the cylinder 51 and is held in place by nuts 59 on the upper ends of rods 61, the lower ends of which are threaded into the plate 53. By tightening the nuts 59 the parts 51, 53, and 57 are firmly connected to each other and a liquid-tight joint is maintained at the bottom.

Within the chamber formed by the cylinder 51 and bottom plate 53 are the main pump elements comprising an upper inner cylinder 65 and a lower outer cylinder 67. The upper member 65 is substantially solid so that it may be properly described as a plunger, but has a delivery duct 69 running axially through it, as seen in Fig. 6. The upper end of the cylinder of plunger 65, as best seen in Fig. 9, is drawn upwardly by screws 71 so as to be held firmly against a gasket 73 on a downwardly faced annular seat on a member 75 which covers a central opening in the previously mentioned top member 57 and is held thereto by screws 77. Resilient washers 79 are preferably used under the heads of the screws 71 so that the resilience of the washers, together with the resilience of the gasket 73, maintains a liquid-tight joint at the top of the member 65 at all times.

The member 75 is recessed at 83 (Fig. 9) to provide space for receiving the head of a screw 85 threaded into the upper end of the plunger 65, coaxially with the bore 69. A washer 87 underlies the head of the screw 85 and is of slightly smaller diameter than the screw head, as shown. An annular disk valve member 89 surrounds the washer 87 with a fairly close but readily slidable fit. This valve member is of fairly thin and readily resilient and flexible metal, thinner than the washer 87, so that the valve member may move upwardly until its inner edge is in contact with the lower surface of the screw 85, and then after further movement of the inner edge of the valve member is stopped by the head of the screw, the outer portion of the valve member may bend upwardly so that the valve becomes dished, allowing greater flow of liquid past the valve. When the flow stops, the valve resiliently springs back to its plane position. An annular groove 91 underlies the valve 89, and this groove is supplied with liquid by a series of oblique ducts 93 which run from the groove 91 to the upper end of the main bore or duct 69.

The member 67, briefly mentioned above, is a hollow cylinder having smooth inner walls providing a snug sliding fit on the smooth exterior surface of the plunger 65, leakage being prevented by packing rings 101 and 103 (Fig. 6) set in annular grooves extending around the member 65 near its lower end. The bottom of the cylinder 67 is closed by a bottom plate 105 held to the cylinder by screws 107. A series of inlet ports

109 (Figs. 7 and 8) extend through the bottom 105 and lead to an annular groove 111, overlying which is an inlet valve 113 of thin, flexible, and resilient metal of annular form, substantially identical with the outlet valve 89 previously described. As in the case of the outlet valve, the inlet valve 113 surrounds a washer 115 which is thicker than the inlet valve, and the upward motion of the valve is limited by the head of a screw 117 screwed into the bottom plate 105. During the intake stroke of the pump the pressure of liquid coming up through the ducts 109 and filling the groove 111 not only lifts the valve 113 to the extent permitted by the screw 117, but also dishes the valve or bends its outer edges upwardly as shown diagrammatically by dotted lines in Fig. 7.

The main body or reservoir 51 is kept filled with the cutting oil or coolant, approximately to the level indicated at 121 in Fig. 4. When the pump operates, the member 65 remains stationary, and the member 67 moves vertically. During the downward movements of the member 67, the inlet valve 113 opens and the coolant enters and fills the space within the member 67 below the member 65. During the upward stroke of the member 67, the inlet valve 113 closes and the liquid is forced up the duct 69, opening the outlet valve 89 and entering the space 83. Thence it is forced up through the delivery duct 125 (Figs. 6 and 9) and through the nipple 127 (Figs. 4 and 6) to a metal block 129 bored to provide ducts 131 and 133 intersected and communicating with each other. From the latter, the liquid flows through the elbow conduit fitting 135 to a suitable delivery conduit such as the flexible tube or hose 137 which, in the illustrative example shown in Fig. 1, delivers the coolant through a nozzle 139 directly to the place where the tool 41 is operating upon the work 43. A suitable standard or bracket 141 is provided on the work table 45 to hold the conduit 137 in proper proximity to the tool.

To effect the upward and downward movements of the pump member 67, this member has fixed to one side of it a bracket 151 (Figs. 4, 5, and 6) which is connected by a set screw 153 to the lower end of a vertical rod 155 extending upwardly through an opening in the member 75 and through a guiding bore in the block 129. A fixture 157 secured to the upper end of the rod 155 is provided with a laterally extending pin 159, to which is connected the upper end of a coiled tension spring 161, the lower end thereof being connected to a ring 163 fixed to the member 75 so that the spring constantly tends to move the rod 155 downwardly, and thus to maintain the pump cylinder member 67 in its lowermost position.

The fixture 157 also has connected to it the lower end of a flexible cord or cable 171 (Figs. 1 and 4) which passes upwardly over a guide pulley 173 mounted on a bracket 175 fixed to a post 177 rising from the block 129. Beyond the pulley 173, the cord or cable 171 extends to some suitable moving part of the machine tool so arranged that the cord or cable is pulled proportionately to and in synchronism with the feeding movements of the tool. For example, in the case of a drill press such as shown in Fig. 1, the upper end of the member 171 may be fixed to a pulley or sheave 181 rigidly secured to the feeding shaft 31 to turn therewith. As this shaft is turned in a counterclockwise direction when viewed as in Fig. 1 by means of the handles 33,

this rotary motion of the shaft feeds the tool 41 downwardly into the work, and at the same time winds the member 171 on the pulley 181, to pull the member 171 to raise the rod 155 and thus to raise the pump cylinder member 67, forcing the coolant upwardly through the hose 137 and delivering it directly to the tool. The delivery of coolant continues so long as the feeding movement of the tool continues. The moment the feeding movement of the tool ceases, the pull on the cord 171 likewise ceases and consequently the delivery of coolant ceases. When the rotation of the shaft 31 is reversed to raise the tool from the work, the cord 171 unwinds from the pulley 181 and the spring 161 pulls the rod 155 downwardly, lowering the pump cylinder 67 and filling it with coolant ready for the next upward delivery stroke.

The valves 89 and 113, having the flexible resilient construction above described, are found in practice to be extremely sensitive and effective, closing instantly when the movement in one direction or the other stops, so that there is no lost motion when movement in a reverse direction begins, and the conduit 137 is kept at all times full of coolant even while the pump cylinder 67 is making its downward travel. The moment the cylinder 67 begins to move upwardly in response to a downward feeding movement of the tool 41, the delivery of coolant begins instantly because of the fact that there is no lost motion in the pump valves and that the conduit 37 is kept filled with coolant.

Occasionally, as for example when the work is particularly tough and the feeding movement is relatively slow, it is necessary to deliver extra quantities of coolant in addition to the quantity normally delivered per inch of feeding movement of the tool. In order to accomplish such extra delivery easily, there is provided an auxiliary operating arrangement comprising the operating lever 201 (Figs. 1, 3, and 4) including two side bars spaced laterally from each other and connected at their upper ends by the cross piece or handle 203. Intermediate their ends the bars 201 are pivoted at 205 on a fixed pivot supported on the stationary member 127. The lower ends of the bars 201 are pivoted at 207 to links 209 pivoted also to a block 211 (Figs. 2 and 4) secured by a set screw 213 to the rod 155. If the upper ends of the bars 201 are moved downwardly, this will pull upwardly on the links 209 and thus raise the rod 155 to cause upward movement of the pump cylinder 67 quite independently of any pull on the cord 171. Hence if the operator sees that additional coolant is needed at any time during the operation of the machine he may depress the auxiliary feed lever 201 momentarily to an extent sufficient to deliver the required amount of additional coolant. This may be done by hand, or more conveniently by the foot. If the lever 201 is not in a convenient position for the foot of the operator to come down upon it, a treadle may be placed wherever it is most convenient to the operator's foot and may be connected by a cord or chain to the member 203.

Surplus coolant drains from the work to a suitable sump on the work table 45, whence it is led through a conduit 221 (Fig. 1) to a pocket 223 (Fig. 4) formed in a lateral extension of the cover member 57. From this pocket the excess coolant drains through an elbow 225 and nipple 227 back into the main coolant reservoir 51 for use over again.

To illustrate graphically the fact that the in-

vention is not limited to a drill press but may be applied to any machine tool having a substantial feeding movement, there is shown in Fig. 10 the application of the same invention to a conventional engine lathe. Such lathe comprises the usual bed 301, head stock 303, tail stock 305, carriage 307, apron 309, lead screw 311, cross slide 313, and tool post 315 holding a cutting tool 317 operating upon work such for example as the work piece 319 held between the centers 321 and 323. In this case, the flexible conduit 137 for delivering the coolant or cutting oil is held by a bracket 331 mounted on and moving with the carriage 307, so that as the carriage feeds along the bed of the lathe the delivery nozzle 139 remains in proper position to deliver the coolant onto the cutting end of the tool 317. The operating cord 171 in this instance leads over a guide pulley 335 which may be the same as the previously described guide pulley 173, and extends thence in a direction parallel to the travel of the carriage 307, the end of the cord 171 being connected to a post or bracket 339 on the carriage. As the carriage 307 moves leftwardly, which is the usual direction of feeding motion, this pulls the cord 171 and raises the pump cylinder 67 to cause delivery of coolant so long as the feeding motion continues. The rod 177 of the coolant delivering mechanism may in this instance be held rigidly by cross bars 345 and 347 clamped to the bed of the lathe near its right hand end, and the other parts of the pump may be supported from this rod 177. In all other respects the pump and its manner of operation are the same as previously described.

It is seen from the foregoing disclosure that a mechanism is provided which admirably fulfills the above mentioned objects of the invention. It is to be understood that the foregoing disclosure is given by way of illustrative example only, rather than by way of limitation, and that without departing from the invention, the construction may be varied within the scope of the appended claims.

What is claimed is:

1. Coolant delivery mechanism for a machine tool, said mechanism including a reservoir for holding a supply of coolant, a plunger supported adjacent the top of said reservoir depending downwardly into the reservoir, a cylinder surrounding the lower portion of said plunger and movable upwardly and downwardly on said plunger, and means for moving said cylinder in accordance with feeding movements of the machine tool with which said mechanism is used.

2. Coolant delivery mechanism for attachment to a machine tool having a feeding movement, said mechanism including a pump, a rigid operating member connected to said pump to operate the same, spring means tending to move said member in one direction, a flexible tension member connecting said operating member to a movable part of said machine tool to move said operating member against the force of said spring means in accordance with feeding movements of the machine tool, and an auxiliary operating member to move the same against the force of said spring means independently of movements of said machine tool.

3. A coolant delivery mechanism for attachment to a pre-existing machine tool having a feeding movement and capable of performing a cutting operation during such feeding movement, said mechanism comprising, in combination, a coolant reservoir mounted externally of the machine tool, a reciprocating pump mounted

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within said reservoir, a coolant delivery conduit extending from said pump to the vicinity of said cutting operation, said pump being effective during a stroke in one direction to force coolant from said reservoir through said delivery conduit and being ineffective to force coolant through said conduit when said pump is stationary or is making a stroke in the opposite direction, and a flexible tension member operatively connecting said pump to said machine tool to reciprocate said pump in said one direction during feeding movement of said machine tool and at a rate proportional to the rate of feeding movement of said machine tool.

4. A construction as described in claim 3, further comprising a lever operatively connected to said pump and accessible externally of said machine tool, said lever being manually movable to move said pump through an effective stroke independently of feeding movement of said machine tool, to supply additional coolant beyond the quantity supplied as a result of said feeding movement.

5. A self-contained externally mounted coolant delivery unit for application to a pre-existing machine tool of the type having a cutting tool and a part movable in one direction through a feeding movement to force the cutting tool and the work against each other and movable in the opposite direction to restore said part to initial position, said unit comprising, in combination, a coolant reservoir mounted externally of the machine tool at an elevation lower than said cutting tool, a reciprocating pump associated with said reservoir and likewise located externally of the machine tool, a delivery conduit extending from said pump to the vicinity of said cutting tool, said pump being effective to deliver coolant from said reservoir into said conduit during a stroke of the pump in one direction and being ineffective to deliver coolant into said conduit during a stroke in the opposite direction, a flexible tension member operatively connecting said pump to said part of said machine tool to move said pump in said effective direction from the movement of said part in a feeding direction, and a spring operatively connected to

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said pump to restore said pump in said ineffective direction when said part moves in said opposite direction.

6. A construction as described in claim 5, further comprising a coolant-receiving pocket secured to said reservoir adjacent the top thereof and at an elevation substantially below said cutting tool, a coolant return passageway leading from said pocket into said reservoir, and a return conduit leading from said machine tool in the vicinity of said cutting tool to said pocket, so that coolant after being delivered to said cutting tool through said delivery conduit may flow by gravity through said return conduit to said pocket and thence through said return passageway back into said reservoir.

7. A construction as described in claim 5, further comprising a lever mounted on said reservoir and operatively connected to said pump and projecting laterally from said reservoir in a direction to be accessible to a person operating the machine tool, so that such person may manually move said lever to operate said pump independently of feeding movement of said machine tool, to supply additional coolant beyond the quantity supplied as a result of said feeding movement.

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