This invention relates to apparatus for cooling cutting tools, etc. and more specifically to a mist spray ring for accomplishing such operation. Fluid material is atomized at the nozzles of the spray ring and directed to the cutting tool, the work piece or other object. The device may be employed with lathes, milling machines, and like devices. In addition, the device is useful in spray painting, oils and similar material to the outside of any object passed through the center of the spray ring.

In the art of cutting metals, such as forming threads, slots, grooves, etc., high temperatures are generated at the engagement of the cutting tool with the device or piece of material to be cut or formed. If the cutting tool is not lubricated or cooled, deformation and dullness of the tool will result. In addition, tool life will be shortened, thus causing increased tool expense and labor cost. Also, if the work piece is not cooled, the high temperature encountered will cause the metal work piece to expand. Since the measurements would be taken by the machine operator while the metal is hot, the resulting contraction of the metal upon cooling would result in producing unacceptable tolerances in the work piece.

In the past, it has been customary to cool or lubricate the cutting tool and the work piece by flooding these elements with a mixture of coolant lubricant. These coolants may be oils, greases, mixtures suspended in water, etc. The flooding method of cooling produces only a minimum of temperature reduction, is expensive, and requires that the work piece undergo a cleaning operation after forming by the cutting tools. Furthermore, during the flooding operation the machine operator is not able to minutely observe the cutting operation since his view is obscured by the flowing liquid. As a consequence, the flood of liquid must be halted or directed to another point so that the operator may inspect the result of the work. Also, where flooding is used there is a tendency of the fluid to break away from the work and it is not practical to keep it in contact around the periphery.

The present invention proposes to utilize a mist spray ring to direct the lubricant or coolant to the cutting tool and the work piece. The circular ring has a portion removed from its center and the work piece may be fed therethrough. Positioned along the inside periphery of the spray ring are a plurality of nozzles which atomize and direct the spray to the work piece and the cutting tools. In this manner the lubricant can be placed exactly where required. Because of the directive force through the nozzles, the mist can be forced into areas impossible to reach by flooding. Cutting fluid and air are directed to the nozzles via separate annular chambers within the spray ring.

Other uses for the device will be evident. In the manufacture of welded tubing, the tube becomes heated and may be passed through a mist spray ring supplied with cooling fluids. If the tube is to be painted or coated, it may be passed through a second spray ring which is supplied with paint or the coating material.

It is, therefore, an object of the present invention to improve cooling devices utilized with machine tools. It is a further object of the present invention to increase tool life and permit machining with increased speed.

It is a still further object of the present invention to more adequately cool cutting tools.

It is another object of the present invention to provide a spray ring which induces a refrigerant action from compressed air tending to cool the cutting tool and the work piece and at the same time reduce the amount of lubricant required.

It is still another object of the present invention to provide a mist spray ring whose operation results in a comparatively unsooted product after machining and requiring less clean-up at the machine.

It is a further object of the present invention to improve paint spraying or coating operations of objects having certain geometrical shapes.

The mist spray ring of the present invention receives a fluid coolant and air and directs the mixed fluid and air (atomized) to the cutting tool and the work piece. The air is mixed with the fluid coolant at the nozzle tip and the refrigerant action of the expanding compressed air takes up the heat, thus tending to cool the cutting tool and the work piece. In addition, the cool fluid itself will reduce the temperature of the cutting tools and the work piece as well. With increased cooling of the cutting tool and the work piece, longer tool life is assured and increased speeds during the machining process may be obtained. The device eliminates the "muss" usually found around machines which employ a flooding operation; therefore, in the interest of safety, a safer place is created for the machine operator to perform the machining process. The machine operator is able to observe the machining process at all times and the mist spray ring operates with a minimum of fluid coolant or lubricant.

With the increased tool life which results from the use of the mist spray ring, the costly cutting tool thus remains sharp and may be employed in the machining operation with closer tolerances. A major portion of the "down time" of a machine results from the replacement of the cutting tool. Since the need to replace the cutting tool has been greatly decreased, greater production through increased operation speeds of the machine are obtained.

These and other features of the invention will be best understood and appreciated from the following description of a preferred embodiment thereof selected for purposes of illustration and shown in the accompanying drawings in which:

FIG. 1 is an elevation view of an embodiment of the invention and showing the mist spray ring with its external fluid coolant and air supplies and controls.

FIG. 2 is an enlarged elevation view of the mist spray ring;

FIG. 3 is a sectional view taken along the line 3-3 of the FIG. 2; and,

FIG. 4 is a cross-sectional view of one of the nozzles of the spray ring and showing in detail the fluid coolant and air chambers.

In FIG. 1, the mist spray ring 10 having the nozzles 12 is shown connected to the machine 14. The machine 14 may be a lathe, a milling machine, or similar machine device. The work piece 16 passes within the aperture of the spray ring 10 to be cooled by the spray from the nozzles 12. A cutting tool, not shown, would be mounted upon the machine 14 by any suitable means and would engage the work piece to perform the necessary machining operation. In addition, the work piece would be in a position to be cooled by the spray from the nozzles 12 of the spray ring 10.

A fluid coolant, such as cooling fluid mixed with a liquid, cutting oil, etc., is stored in the fluid supply 18. A pump 20, which may be driven by any suitable means, is connected to receive the contents of the fluid supply tank 18 via the conduit 22 and direct its output to the distributing valve 24 via the conduit 26. A relief valve
8,088,454

28 is connected to the pump 20 and will return any excess fluid to the supply tank 18 via the conduit 30.

The output of the distributing valve 24 is directed to the conduits 32, 33 and 34. When the fluid coolant leaves the distributing valve 24 and enters the conduit 32, it is directed to the mist spray ring 10 via the regulating valve 34 and the solenoid operated valve 36. The pressure of the fluid coolant may be indicated by the gage 38.

Additional outputs from the distributing valve 24 are to the conduits 32 and 33 which will serve to supply fluid coolant to other spray rings employed with other machine tools.

An air supply is maintained in the air tank 40 by operation of the compressor and motor 42. Within the connecting conduit 44 between the compressor and motor 42 and the air supply tank 40 is the check valve 46. The check valve 46 serves to prevent the escape of air from the air tank 40 when the compressor and motor 42 are not supplying a quantity of air to the air tank 40.

The output of the air tank 40 is to the distributing valve 50 via the pipe or conduit 48. The output of the distributing valve 50 is directed to the conduits or pipes 52, 53 and 54. The conduit 52 supplies the mist spray ring 10 on the machine 14 and the conduits 52 and 53 supply other spray rings utilized with other machine tools.

The air supply in the conduit 52, before reaching the spray ring 10, passes through the regulating valve 54 and the solenoid valve 56. The air pressure is determined by the gage 58.

It will be noted that the regulating valves 34 and 54, the solenoid operated valves 36 and 56 and the gages 38 and 58 are contained within the control cabinet 60. The control cabinet 60 is located near the machine operator so that the desired pressures of fluid coolant and air may be controlled. The fluid coolant tank 18, the air supply system 40, the distributing valves 24 and 50, and the other elements coupled thereto may be located external to the machining area and in any area which is convenient to be serviced. If the fluid supply tank 18 is located near the spray ring 10, then the pump 20 and its associated relief valve 25 and conduits may be dispensed with since the spray ring 10 will be served with fluid supply through the force of gravitational flow.

Also contained with the control cabinet 60 is the switch control 62. The switch control 62 has the operating knob 64. The operating knob 64 has a "test" position, an "off" position, and an "automatic" position. The electrical circuit includes the power source 66, the winding 68 of the solenoid valve 36, the winding 70 of the solenoid valve 56, and the machine switch 72. The windings 68 and 70, which are in parallel, are supplied by the electrical conductors 74 and 76. The switch 72 is coupled to the electrical conductors 78 and 80.

When the operating knob 64 is in the "off" position, no current is supplied to the solenoid windings 68 and 70 of the solenoid operated valves 36 and 56, respectively, and therefore the valves 36 and 56 remain closed and pass no fluid coolant or air. When the machine operator wishes to utilize the mist spray ring 10, the regulating valves 34 and 54 are opened until the desired pressure is indicated on the gages 38 and 58. Assuming that both the fluid supply tank 18 and the air supply tank 40 are filled, a starting pressure for the two fluids may be for example, 50 lbs. The operator now places the operating knob 64 in the "test" position (rotated clockwise) which passes current from the power source 66 through the windings 68 and 70 thus opening the solenoid operated valves 36 and 56. Fluid coolant and air are now supplied to the nozzles 12 of the spray ring 10.

The operator may now vary the fluid coolant supply by rotating the regulating valve 34 and the control connected to the regulating valve 54. When the desired spray or atomization is obtained from the nozzles 12 of the spray ring 10, the machine operator will then rotate the operating knob 64 clockwise to the "automatic" position. With the machine switch 72 open, and the operating knob 64 in the auto (automatic) position, no current is supplied to the windings 68 and 70 of the solenoid operated valves 36 and 56. Thus, no fluid will be supplied to the nozzles 12 of the spray ring 10 when the operating knob 64 is in the "automatic" position unless the machine switch 72 is closed. The purpose of the "automatic" position of the operating knob 64 on the switch control 62 is to operate and provide materials to the nozzles 12 and the spray ring 10 only when the machine 14 is turned on and cutting or forming the work piece 16.

With the regulating valves 34 and 54 now adjusted, and the operating knob 64 in the "automatic" position the machine operator is now ready to start the machine and perform a cutting operation. When the machine 14 is started by closing the switch 72, the work piece 16 will be rotated (by means not shown), and current will be supplied to the windings 68 and 70 over the conductors 74 and 76 from the power source 66. With current now passing through the windings 68 and 70, the solenoid operated valves 36 and 56 will open and thus supply fluid coolant and air to the nozzles 12 of the spray ring 10. The supply will be maintained to the spray ring 10 as long as the machine switch 72 is closed. When the machine operator opens the machine switch 72 to stop the rotation of the work piece 16, current through the windings 68 and 70 will be inhibited thus halting the supply of fluid coolant from the conduit 32 and air from the conduit 52. Thus, a great savings in coolant results since coolant and air are supplied only when needed.

It was stated that the work piece 16 will rotate when the machine switch 72 is closed. In the case of a milling machine, it will be understood that the workpiece may be stationary and the machine tool rotating or oscillating.

The electrical wiring within the switch control 62 is relatively simple. When the operating knob 64 is in the "off" position, no current is supplied to the windings 68 and 70. When the operating knob 64 is in the "test" position, current from the power source 66 is supplied to the windings 68 and 70 to actuate their respective valves. When the operating knob 64 is in the auto (automatic) position, a series circuit is obtained. The series circuit proceeds from the power source 66, through the "automatic" switch position 62, through the windings 68 and 70, to the conductor 76, to the conductor 78 and to the machine switch 72. When the machine switch 72 is closed, the electrical conductor 80 will return the current to the power source 66.

An enlarged elevation view of the mist spray ring 10 is shown in the FIG. 2. The diameter of the spray ring 10 may vary from approximately a few inches to several feet depending upon the physical size of the work piece. In the spray ring 10 which was constructed and operated in accordance with the principles of this invention, the outside diameter of the ring 10 was six inches and the inside diameter was three and one half inches.

The nozzles 12 are mounted on the beveled surface 82, which beveled surface 82 forms approximately a 45° angle with the surfaces 84 and 86 shown in the FIG. 3. The surface 86 of the inside diameter, which is perpendicular to the front surface 84, extends beyond the tip of the nozzle 12 so that any engagement of the work piece 16 of the nozzle 12, with the inside diameter, will not bend or fracture the nozzles 12. Thus, by mounting the nozzles 12 on the beveled surface 82, a protective position is maintained for the nozzles 12 whereby destruction of the nozzles 12 is not likely. It will be understood that any number of nozzles 12 may be mounted. An example coupled to the present surface 86, for purposes of simplicity, only four nozzles have been shown.

Air is supplied to the nozzles 12 by the pipe or conduit 52. Similarly, fluid coolant is applied to the nozzles 12 by
the pipe or conduit 32. The inner annular chambers connecting the conduits 32 and 52 to the nozzles 12 are shown in detail in FIG. 3. Also, the sealing means 90 is described in FIG. 5. By forming the mist spray ring 10 taken along the line 3-3 of FIG. 2, is shown in FIG. 3. It will be evident that the exterior surfaces which comprise the outside periphery, the front surface 84, the back surface 88, the surface of the inside diameter 86 and the beveled surface 82 may be formed by any well known machining operation or may be cast in this form. It is then necessary to form the air chamber 94 and the fluid coolant chamber 96. In addition, the threaded holes 98 (shown best in FIG. 4) must be formed.

The spray ring 10 is placed in the work piece position of a lathe and a cutting tool may be applied to gouge out the material forming the annular air chamber 94. Likewise, a cutting tool may be applied to the surface 88 to form the annular fluid coolant chamber 96. The air chamber 94 and the fluid coolant chamber 96 are continuous around the entire surface of the spray ring 10 so that they will serve any nozzles 12 located upon the beveled surface 82. The air chamber 94 is supplied with air from the conduit 52 shown in the other drawings and the fluid coolant chamber 96 is supplied with fluid coolant through the conduit 32 also shown in the other drawings.

After the air chamber 94 and the fluid coolant chamber 96 are formed, the hole to insert the nozzle 12 is drilled and threaded. The hole 98 for the nozzle 12 is formed at approximately 45° to the front surface 84 and the surface 86 of the inside diameter. The drilling of the hole 98 and the placing of the nozzle 12 will be such that the fluid coolant will be supplied to the longitudinal internal passage of the rectangular jet 100 and the air may be supplied to the chamber surrounding the rectangular jet 100. Thus, any number of nozzles 12 may be mounted around the beveled surface 82 and all will be supplied with fluid coolant and air from the chambers 94 and 96, respectively.

FIG. 6 shows an enlarged view of the annular passages or chambers 94 and 96 and the nozzle 12. After the chambers 94 and 96 have been formed as hereinbefore described, and the hole 98 drilled and tapped and the connecting chamber from the hole 98 to the fluid coolant chamber 96 connected by drilling, the spray ring 10 must be drilled and tapped in two places about its outside periphery to permit the fluid coolant to enter the fluid coolant chamber 96 and the air to enter the air chamber 94. Only the drilled and tapped hole 102, to permit the entry of the fluid coolant to the fluid coolant chamber 96, is shown. It will be understood that a similar hole will be drilled, tapped and connected to permit air to fill the air chamber 94.

It is necessary now to apply the sealing means 90 to the air chamber 94 to inhibit the escape of the air to the atmosphere. The sealing means 90 may be force fitted into the air chamber 94 and may be of any suitable material, such as a metal seal, an epoxy resin, etc. Similarly, sealing means 92 must be fitted along the outside surface of the fluid coolant chamber 96 to prohibit the escape of fluid coolant from the side of the spray ring 10. The sealing means 92 would be similar in construction and method of applying as the sealing means 90.

As shown in FIG. 4, the nozzle 12 is cylindrical having an inside portion removed to permit the entry of the rectangular jet 100. At the end opposite to where the jet 105 is inserted into the nozzle 12, the orifice 105 is formed from which the mixed air and fluid coolant escapes. The longitudinal hole 104 in the jet 100 supplies fluid coolant to a mixing chamber 110 which is located just before the orifice 105 at the end of the nozzle 12. At the exit of the fluid coolant from the longitudinal hole 104 to the mixing chamber 110, is the constricted portion 106 which is of a diameter smaller than that of the diam-
been described in connection with the accompanying drawings, it will be understood that any modifications as to form, use, arrangement of parts and material may be made without departing from the spirit and scope of the invention.

What is claimed is:

1. A fluid spraying system for applying a fluid to a work piece comprising a unitary spray ring member having substantially parallel opposed sides and an inner diameter adapted to surround the work piece, a beveled surface formed between a side of said member and said inner diameter, a plurality of inwardly directed nozzles mounted upon said beveled surface to direct the fluid onto the work piece, the inward extent of said nozzles terminating short of said inner diameter to protect said nozzles from damage by the work piece, a mixing chamber within said ring member for each of said nozzles, a pair of annular grooves of different diameter located on opposite sides of said ring member and being concentric with said inner diameter, sealing means extending inwardly from each of said sides in each groove defining with said groove an annular closed passageway, means separately connecting said closed passageways to each of said mixing chambers, first conduit means for connecting one of said passageways to a first source of fluid, and second conduit means for connecting the other of said passageways to a second source of fluid.

2. The combination according to claim 1 wherein said means for connecting said passageways to said sources of fluid include a manually operated valve and a remotely controlled electrically actuated valve connected in series.

3. The combination according to claim 1 including means to vary the pressure of the fluid supplied to the nozzles.

References Cited in the file of this patent

UNITED STATES PATENTS

2,077,237 Ofedt ------------ Apr. 13, 1937
2,433,463 Lampe ------------ Dec. 30, 1947
2,585,133 Kemphorne ------- Feb. 12, 1952
2,623,944 Bloom ------------ Jan. 20, 1953
2,683,625 Fisher ----------- July 13, 1954
2,698,112 Herderhorst ----- Dec. 28, 1954
2,732,258 Fisher ------------ Jan. 24, 1956