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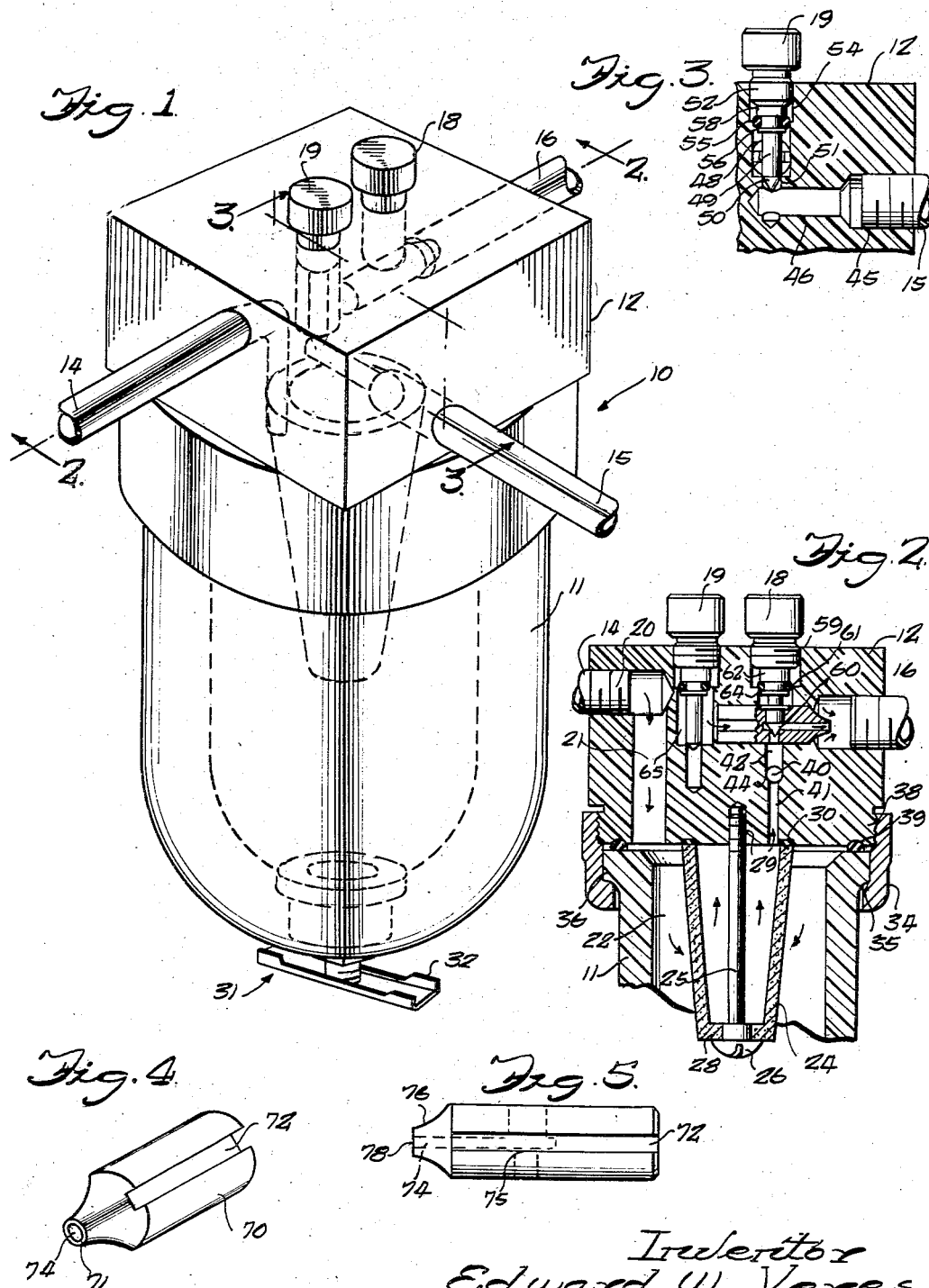
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2,850,323

MIST COOLANT ATOMIZER

Filed July 15, 1955

2 Sheets-Sheet 1



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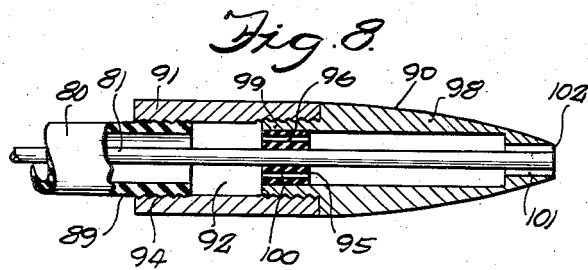
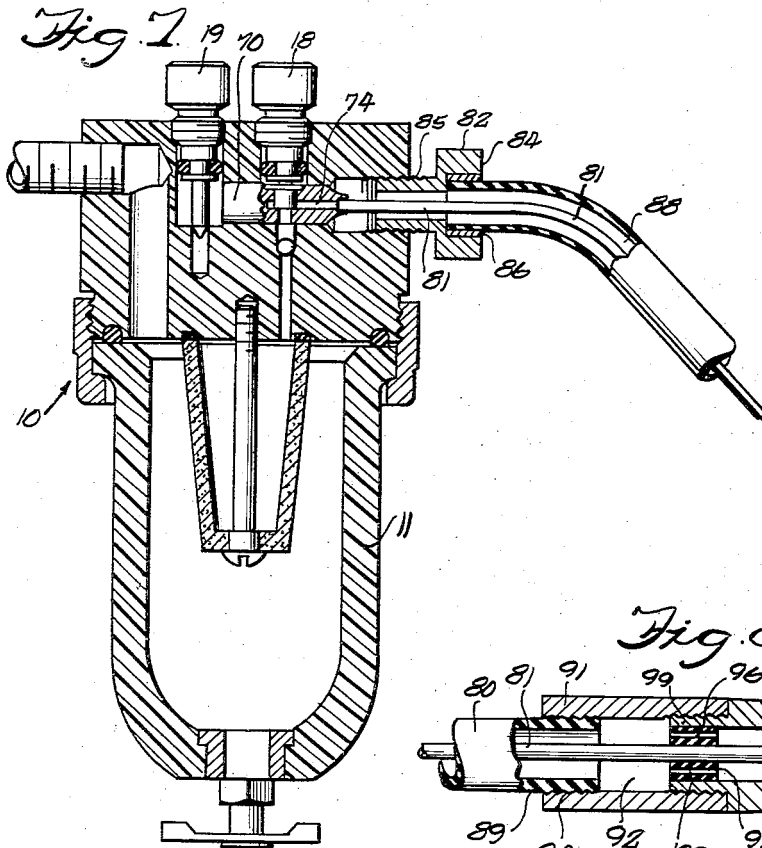
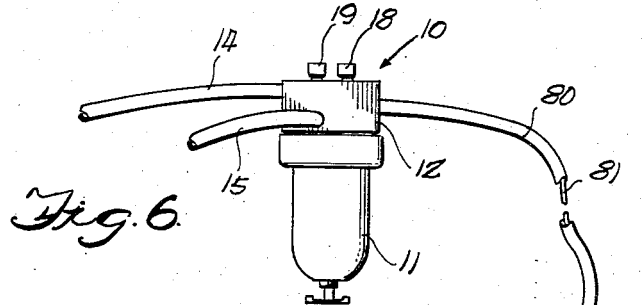
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MIST COOLANT ATOMIZER

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14 Claims. (Cl. 299—86)

The present invention relates to the general field of cooling cutting tools. More specifically the invention contemplates a device for delivering coolant in a mist form to the cutting area.

In the cutting of metals, particularly on heavy duty operations, some system for constantly cooling the cutting tool is generally employed. Most such cooling systems provide for circulating fluid over the cutting tool which serves to lubricate as well as flood the cutting edge with a liquid bath. More recently a trend has developed to atomize the coolant so as to envelop the cutting edge in a mist. Normally air under pressure is used to atomize the coolant and provide the mist. Independent of the mist coolant, a flood coolant system of the tool is often employed. In many systems these independent atomizing units are located in close proximity to the cutting edge and consequently often interfere with the operator's freedom in running his machine. Numerous other disadvantages are inherent in the very complexities of the available mist coolant devices.

Accordingly the present invention has as its principal object providing a mist coolant system adaptable for use with cutting tools having a pre-existing flood coolant system which is simple, inexpensive, and efficient.

Another object of the invention is to provide a mist coolant attachment which can be located on its associated cutting machine at a point remote from the cutting tool.

Yet another object of the invention is to provide a mist coolant attachment for a cutting tool which can be selectively employed with the existing flood system.

Still another object of the invention is to provide a mist coolant attachment which operates to mix coolant and air under pressure having a control system which can be simply, accurately, and safely adjusted by the operator while the cutting tool is operating.

Yet a further object of the invention is to furnish a mist coolant attachment which readily permits a visual inspection of the flow and supply of coolant.

Still a further object of the invention is to provide a mist coolant attachment adaptable to generate an effective mist in remote or shifting locations.

Further objects and advantages of the present invention will become apparent as the detailed description of an illustrative device proceeds, taken in conjunction with the accompanying illustrative drawings, in which:

Figure 1 is a perspective view of a mist coolant atomizer illustrating the present invention and showing the spaced relation of some of its principal elements in phantom form.

Fig. 2 is a broken partial vertical section taken along section line 2—2 of Fig. 1.

Fig. 3 is a partial broken vertical section taken along section line 3—3 of Fig. 1 on a plane at right angles with the plane of the section shown in Fig. 2.

Fig. 4 is a perspective view of the atomizing nozzle.

Fig. 5 is a view in front elevation of the atomizing nozzle shown in perspective in Fig. 4.

Fig. 6 is a plan view in reduced scale showing the mixing unit employed with a flexible tube connection and remote nozzle.

Fig. 7 is a sectional view taken along section line 2—2 of Fig. 1 showing in enlarged scale the flexible hose adapter attached to the mixing unit.

Fig. 8 is an enlarged view in partial section of the mixing nozzle shown in Fig. 6, taken along section line 8—8 of Fig. 6.

The heart of the mist coolant system contemplated by the present invention lies in the unique combination of a mixing unit and nozzle. A typical atomizing unit illustrative of the invention is shown in the accompanying drawings and will be described in detail. In broad outline, however, the mixing unit contemplates a coolant reservoir and source of air pressure. The air and coolant being controlled to converge at a unique nozzle where the coolant is atomized. Provision has been made to permit the user to select whether the mist will be delivered through a tube to the cutting edge, or whether the nozzle will be employed at a remote location. In Fig. 1 it will be seen that the unit contemplates a transparent reservoir bowl 11 and a head 12. Entering the head at substantially right angles are a coolant inlet 14 and an air inlet 15. After the coolant has been atomized it leaves the atomizer unit 10 through a pressure mist outlet 16. Control of the flow of pressure coolant and air is accomplished by adjusting the coolant knob control 18 and air control knob 19 located atop the mixer unit head 12.

In Fig. 2 the details of the coolant and air flow are more fully shown. The coolant pipe 14 is secured in the horizontal coolant inlet passageway 20 and then flows downwardly through the vertical coolant passageway 21 into the reservoir chamber 22. Because the reservoir wall 11 is of a transparent material, the quantity of coolant within the unit may be visually inspected at all times as well as the relative cleanliness of the coolant.

In order to insure the delivery of contamination-free coolant to the cutting edge the coolant is filtered by a cup-shaped filter unit 24, in the present instance shown as a sintered metal cup secured to the mixer head 12 by means of the filter mounting bolt 25. The head 26 of the mounting bolt 25 impinges on the base 28 of the filter 24, being laterally engaged with a mounting bore 29 in the base of the mixer head 12 and urging the filter unit and the contact with the annular filter washer 30 mounted in the base of the head 12. The nature of the mounting of the filter unit 24 renders it readily removable for cleaning. A threaded mounting ring 34 surrounds the reservoir bore 11 with a lower annular shoulder 35 engaging the upper annular shoulder 36 of the bore. The upper portion of the annular ring 34 is threaded internally to mate with the threaded base portion 38 of the head 12. An O-ring 39 provides the seal for the reservoir against the bottom of the mixer head 12. In addition to the filter unit, a drain unit 31 is provided in the base of the reservoir 11 permitting the removal of sedimentation by turning the valve handle 32.

In order to insure a supply of pressure coolant immediately available for introduction into the mixing chamber a ball check valve 40 has been provided in the coolant reservoir discharge passageway 41. The ball check 40 is freely floating in an enlarged portion 42 of the coolant passageway and seats against a chambered shoulder 44.

Since the pressure air flow enters the mixer head 12 at right angles with the coolant, the details of that arrangement have been shown in sectional view in Fig. 3. There it will be seen that the inlet pipe 15 is threadedly mounted in the inlet horizontal passageway 45 and leads

into the central portion of the mixer head 12 through a reduced diameter inlet passageway 46. After the pressure air approaches the mixing chamber it should, in normal operation, pass through a restrictor in order to reduce the working air pressure, normally 90 p. s. i., in most installations, to approximately 40-60 p. s. i. To accomplish this pressure reduction a needle valve assembly 48 has been provided controlled by the air flow control knob 19. The needle valve 49 has a pointed head 50 which seats in a vertical bored orifice 51 at the upper portion of the reduced diameter inlet section 46. The needle valve is threaded on a collared portion 52 which mates with threads in the needle valve passageway 54 providing for incrementally advancing the needle valve point 50 into the seat 51. An O-ring 55 surrounds the needle valve and is flanked by shoulders 56, 58 thereby effecting a leak-proof seal above the needle valve.

Referring again to Fig. 2, it will be seen that the coolant flow is controlled by a needle valve similar in construction to the air flow needle valve described above. As the coolant flow needle valve adjustment knob 18 is rotated the threaded portion of the needle valve body 59 incrementally advances the point 60 of the needle valve into contact with its seat in the mixing nozzle 70. The details of construction of the nozzle 70 will be discussed later. An O-ring 61 flanked by shoulders 62, 64 seals the coolant flow control needle valve in the atomizer head 12.

A unique atomizing nozzle, shown in perspective in Fig. 4, is employed to direct the flow of coolant and pressure air to effect an atomization at its nose 71 creating a mist of the coolant and air which is delivered under pressure through the mist line to the cutting edge. The pressure air, after passing through the air needle valve 48, moves into the pre-nozzle air chamber 65 where it splits up into the parallel air-flow passageways 72 which peripherally and longitudinally flank the longitudinal axis of the nozzle 70. A central bore or liquid-flow passage 74 is provided in the nozzle 70 to discharge the coolant under pressure. The bore 74 terminates at its rear portion in the coolant needle valve seat 75. The forward portion of the nozzle is a convex tapered frusto-conical section 76 which creates a turbulent zone of pressure air immediately adjacent the coolant discharge 78 thereby creating a fine mist which, under pressure, may be delivered through a flexible mist line 16 to the cutting edge of the tool.

For best results it has been found desirable to direct the maximum effect of the spray in close proximity to the cutting edge. Where a shifting cutting edge is involved, or where the cutting edge is relatively inaccessible, a unique flexible tube adapter with a remote nozzle may be utilized. As will be seen in Fig. 6, the mist coolant unit 10 is fed by the coolant inlet 14 and the air inlet 15 and the respective flows of coolant for air are controlled by the control knobs 18, 19 on the mixer head 12. A flexible air hose 80 having a flexible inner coolant line 81 is specially adapted for conveying the pressure air and coolant to a remote nozzle 90 which can be secured to the machine tool in close proximity to the cutting edge.

In greater detail, it will be seen in Fig. 7 that an air hose coupling adapter 82 with an enlarged head 84 and cylindrical threaded body section 85 threadedly engages the mist coolant outlet. A gripping collar 86 is provided in a counterbored portion of the adapter head 84 to sealingly grip the air hose 81. The central coolant tube 81 may be either threaded or press fitted at its end into the hollow bore 74 of the mixer head nozzle 70. In operation, the coolant which is controlled by the coolant needle valve knob 18 is channeled into the coolant tube 81, and the air flow which is controlled by the air flow needle valve control knob 19 bypasses the mixer head nozzle 70 and flows into the air channel passage 88.

Referring now to Fig. 8, it will be seen that the remote nozzle 90 contemplates hose coupling in the form of a rearward skirt 91 with a hollow central portion 92 having internal threads 94 to engage the nozzle end 89 of the air hose 80. The central coolant line 81 passes into the air hose coupling chamber 92 and is then secured in place by means of a supporting collar 95. The collar 95 has a plurality of pressure air bypass ports 96 which permit the air under pressure to migrate directly toward the nose of the nozzle 90. The nose section 98 of the remote nozzle 90 has a threaded reduced diameter portion 99 which engages nose threads 100 on the internal portion of the nozzle skirt 91. A reduced diameter portion 101 is provided at the very end of the nozzle nose 98 to deliver pressure air across the outer terminal 102 of the coolant line.

As the air rushes by the outer end 102 of the coolant line the coolant is picked up and atomized and may thereby be discharged directly on the cutting edge of the associated machine tool. By employing sufficient air pressure, a reduced pressure at the end of the coolant line 102 will be sufficient to cause the unit to siphon coolant through the coolant line 81 from the reservoir 11 of the mixing unit 10, although for best results it is contemplated that the coolant will be delivered under pressure to the remote nozzle 90. The nozzle 90 may be fixed to the associated machine tool by any convenient fastening means.

By employing the flexible air and coolant hose 80, 81 and the remote nozzle 90 the novel mixing unit 10 may be located at a point far removed from the effective cutting edge. In addition, in applications where it may be necessary to effect several bends in the flexible tubing, the quality of the mist delivered will not be materially changed from that which would be delivered at close range to the mixing unit when the internal nozzle 70 accomplishes the atomizing function. The remote location of the nozzle also facilitates delivering the mist to a cutting edge which has an extensive travel such as might be found on a planar or similar machine tool. It is also contemplated that a branching connection may be employed on the combination air hose and coolant line to provide for two or more nozzles located remotely from a single mixing unit.

Operation

The detailed cooperative function of various structural elements described in detail above will be more fully appreciated as the operational cycle is reviewed. On a typical installation, the lathe or milling machine or other cutting machine with which the atomizer unit may be employed normally has a circulating system for flooding the cutting edge with a recirculated and filtered coolant. Such coolants serve the manifold purposes of lubricating, cleaning, chip removal, and cooling as well. These systems are normally provided with the necessary pumping and swarf removal equipment necessary to their operation.

The atomizer unit such as described above is employed in the existing flood coolant system on the machine. A simple pumping attachment, with a shut-off valve, is connected to the positive pressure side of the flood coolant system thereby directing the coolant through the inlet tube 14 into the atomizer unit 10. A source of pressure air is coupled to the air inlet line 15. The atomizer unit is then conveniently mounted to the machine or at any other suitable location where it can be observed and adjusted by the operator, and yet will not interfere with his proper operation of the machine tool.

The coolant then enters the unit and flows through the reservoir bowl 11 and is filtered by the filter unit 24 before being atomized and delivered to the mist coolant line 16. The two-fold filtering of the coolant as well as provision for draining the reservoir bowl doubly insure the delivery of a clean mist to the cutting edge of the

tool. The operator, of course, can visually observe both the cleanliness of the coolant as well as its adequate supply.

Depending upon the nature of the job being cut the operator adjusts the flow of coolant and air by means of the air needle valve control knob 19 and the coolant needle valve control knob 18, located for ready access on the top of the atomizer unit 10. Suitable gauges may be provided on the coolant and air lines to indicate to the operator the quantity of coolant or air being delivered as well as the pressure under which it is being delivered. It is contemplated that other points in the system may be similarly metered and gauged.

The mist coolant delivery line 16 itself is either of flexible tubing or a thin-walled tube that can be bent. The mist is normally delivered behind the cutting edge and subsequently flows about to envelop the entire cutting area. Since air pressure accompanies the mist, various shaped nozzles may be employed to utilize this air pressure to accomplish directional chip removal in accordance with the dictates of the operation being performed. Again depending upon the job being done, the operator can choose whether the remote nozzle and flexible tube are required, or whether the mixing head nozzle will suffice.

Although a particular embodiment of the invention has been shown and described in full here, there is no intention to thereby limit the invention to the details of such embodiment. On the contrary, the invention is to cover all modifications, alternative embodiments, usages and equivalents of the mist coolant atomizer as fall within the spirit and scope of the invention, specification and appended claims.

I claim as my invention:

1. In a mist coolant generator, a mixer head provided with a passage extending therethrough having an inlet adapted to be connected to a source of air under pressure and an enlarged outlet, an adjustable needle valve interposed in said passage for establishing a selectively variable pressure drop thereacross, a reservoir releasably secured to said head and defining a reservoir chamber therein adapted to contain a liquid coolant, said head providing passage means in open communication with said chamber and adapted to be connected to a source of liquid coolant for supplying the same to the chamber, a nozzle mounted within said passage intermediate said valve and outlet in adjacency with the latter and having extending longitudinally therethrough a plurality of air-flow passages disposed thereabout and terminating in communication with said outlet to afford a flow path for air thereto, said nozzle having also a liquid-flow passage terminating in communication with said outlet to afford a flow path for liquid thereto, an adjustable needle valve interposed in said liquid-flow passage for establishing the selectively variable flow rate therethrough, and said head being provided with a flow passage therein connecting said reservoir chamber and liquid-flow passage and having a check valve therein to define a liquid-flow direction from said chamber to said nozzle.

2. The mist coolant generator of claim 1 in which a filter is provided in said chamber in surrounding relation with said flow passage provided by said head so as to filter liquid flowing from said reservoir chamber to said nozzle.

3. The mist coolant generator of claim 1 in which a nozzle extension is provided comprising a pair of coaxially oriented tubes, the innermost of said tubes being connected with said liquid-flow passage and the outermost of said tubes being in communication with said air flow passages, said tubes being characterized by admixing liquid and air flowing therethrough at the outer end thereof.

4. The mist coolant generator of claim 1 in which said nozzle has an inwardly tapered end portion extending into said outlet.

5. In a mist coolant generator of the character de-

scribed, a mixer head provided with a passage extending therethrough having an inlet adapted to be connected to a source of air under pressure and an enlarged outlet, means interposed in said passage for establishing a pressure drop thereacross, a reservoir defining a reservoir chamber therein adapted to contain a liquid coolant, said head providing passage means in open communication with said chamber and adapted to be connected to a source of liquid coolant for supplying coolant to the chamber, a nozzle mounted within said passage intermediate said first mentioned means and outlet in adjacency with the latter and having extending longitudinally therethrough a plurality of air-flow passages disposed thereabout and terminating in communication with said outlet to afford a flow path for air thereto, said nozzle having a liquid-flow passage terminating in communication with said outlet to afford a flow path for liquid thereto, means interposed in said liquid-flow passage for regulating the flow rate of liquid therethrough, and said head being provided with a flow passage therein connecting said reservoir chamber and liquid-flow passage and having a check valve therein to define a liquid flow direction from said chamber to said nozzle.

6. The apparatus of claim 5 in which said first mentioned means comprises an adjustable valve.

7. The apparatus of claim 5 in which said last mentioned means comprises an adjustable valve.

8. In apparatus of the character described, a mixer head provided with a passage extending therethrough having an inlet adapted to be connected to a source of air under pressure and an enlarged outlet, a reservoir carried by said head and defining a reservoir chamber therein adapted to contain a liquid coolant, means for filling said chamber with such liquid coolant, a nozzle mounted within said passage adjacent said outlet and having extending longitudinally therethrough a plurality of air-flow passages disposed thereabout and terminating in communication with said outlet to afford a flow path for air thereto, said nozzle having also a liquid flow passage terminating in communication with said outlet to afford a flow path for liquid thereto, and said head being provided with a flow passage therein connecting said reservoir chamber with said liquid-flow passage.

9. The apparatus of claim 8 in which an adjustable valve is interposed in said first mentioned passage upstream of said nozzle for establishing a pressure drop between said inlet and nozzle.

10. The apparatus of claim 8 in which an adjustable valve is interposed in said liquid-flow passage to selectively adjust the quantity of liquid flowing therethrough.

11. The apparatus of claim 8 in which said plurality of air-flow passages comprise peripheral channels extending along the surface of said nozzle, in which said liquid-flow passage is disposed along the longitudinal axis of said nozzle, and in which said nozzle has an end portion that tapers inwardly and projects into said outlet.

12. In a mist coolant generator of the type described, a mixer head provided with a passage extending therethrough having an inlet adapted to be connected to a source of air under pressure and an outlet, a reservoir carried by said head and defining a reservoir chamber adapted to contain a liquid coolant therein, a nozzle mounted within said passage adjacent said outlet and having an air-flow passage extending longitudinally therethrough to afford a flow path for air from said inlet to said outlet, said nozzle having also a liquid-flow passage terminating at one end in communication with said outlet to afford a flow path for liquid thereto, and said head being provided with a flow passage therein connecting said reservoir chamber with said liquid-flow passage.

13. The apparatus of claim 12 in which said nozzle is an elongated element of substantially the same cross-sectional area as the first mentioned passage so as to fill the same thereacross, and in which said air-flow passage

is defined by a channel formed in the peripheral surface of said nozzle.

14. The apparatus of claim 13 in which at least two of said channels are provided by said nozzle in spaced apart relation thereabout, and in which said liquid-flow passage is disposed along the longitudinal axis of said nozzle.

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