March 22, 1960 J. A. PAASCHE 2,929,566

COOLING METHOD AND APPARATUS FOR METAL WORKING

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Fig. 1.

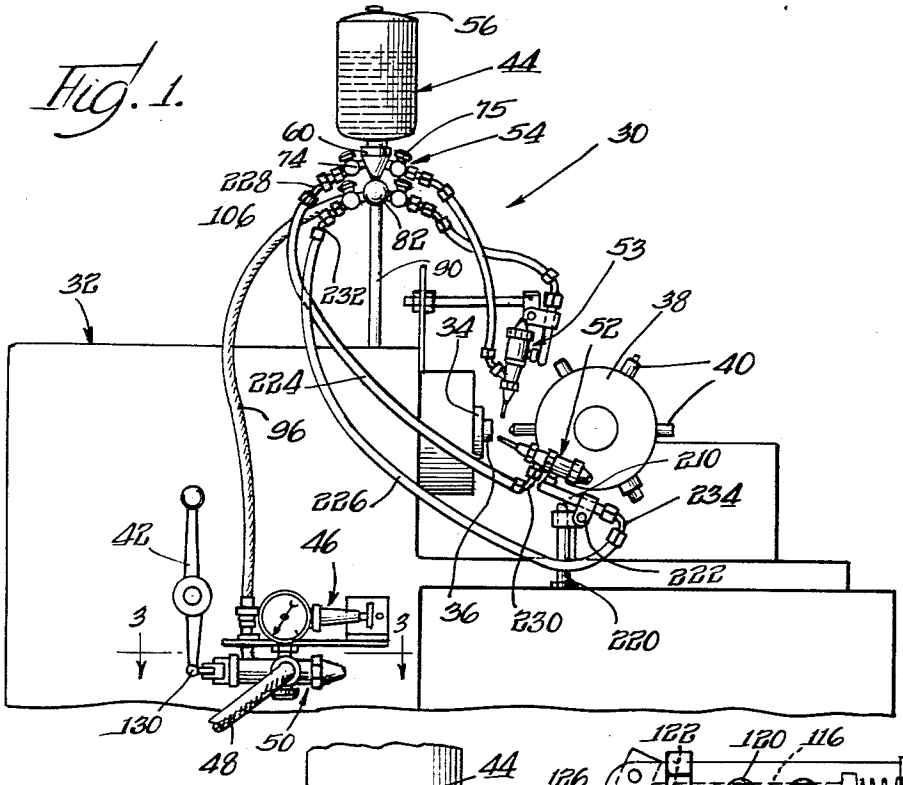

Fig. 2.

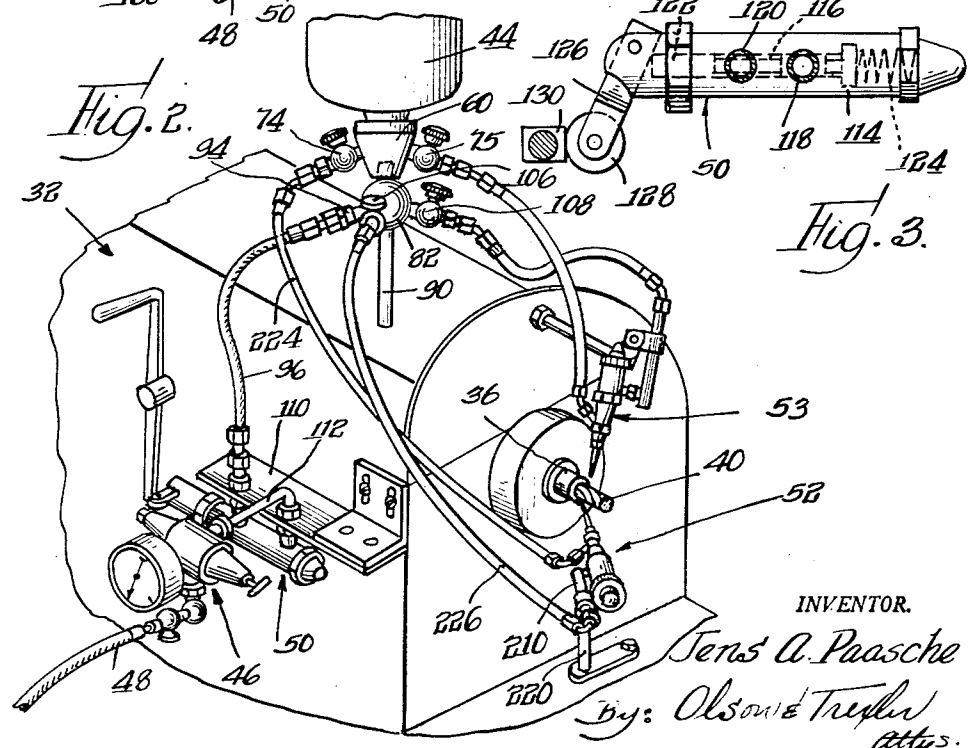

Fig. 3.

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Fig. 4.

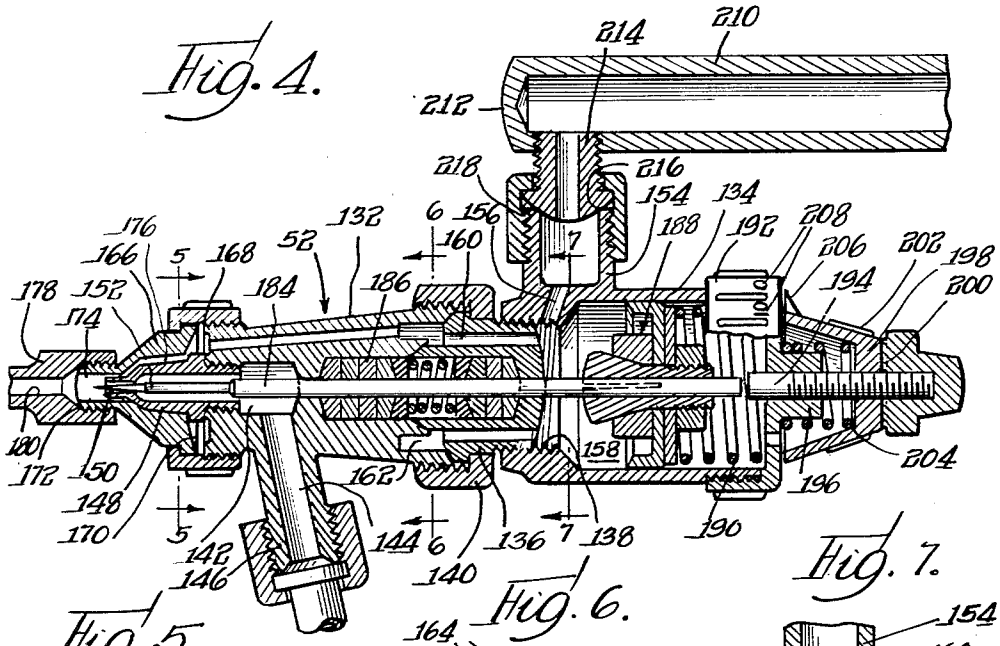

Fig. 5.

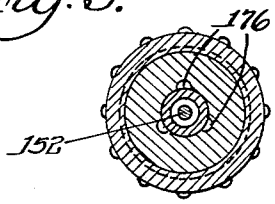

Fig. 6.

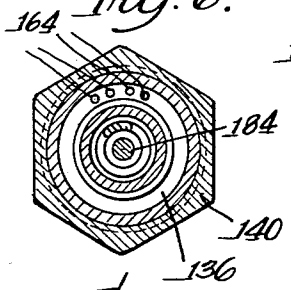

Fig. 7.

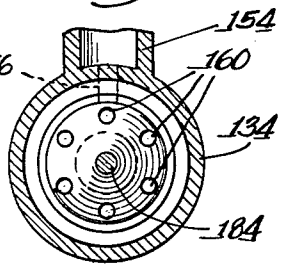

Fig. 8.

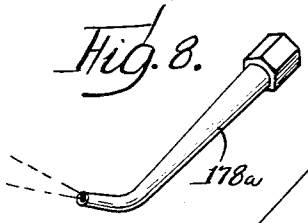

Fig. 9.

Fig. 10.

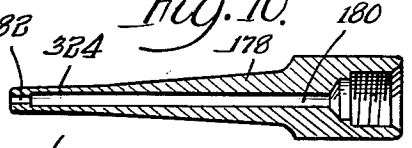

Fig. 11

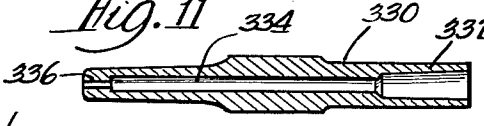

Fig. 12.

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Fig. 13.

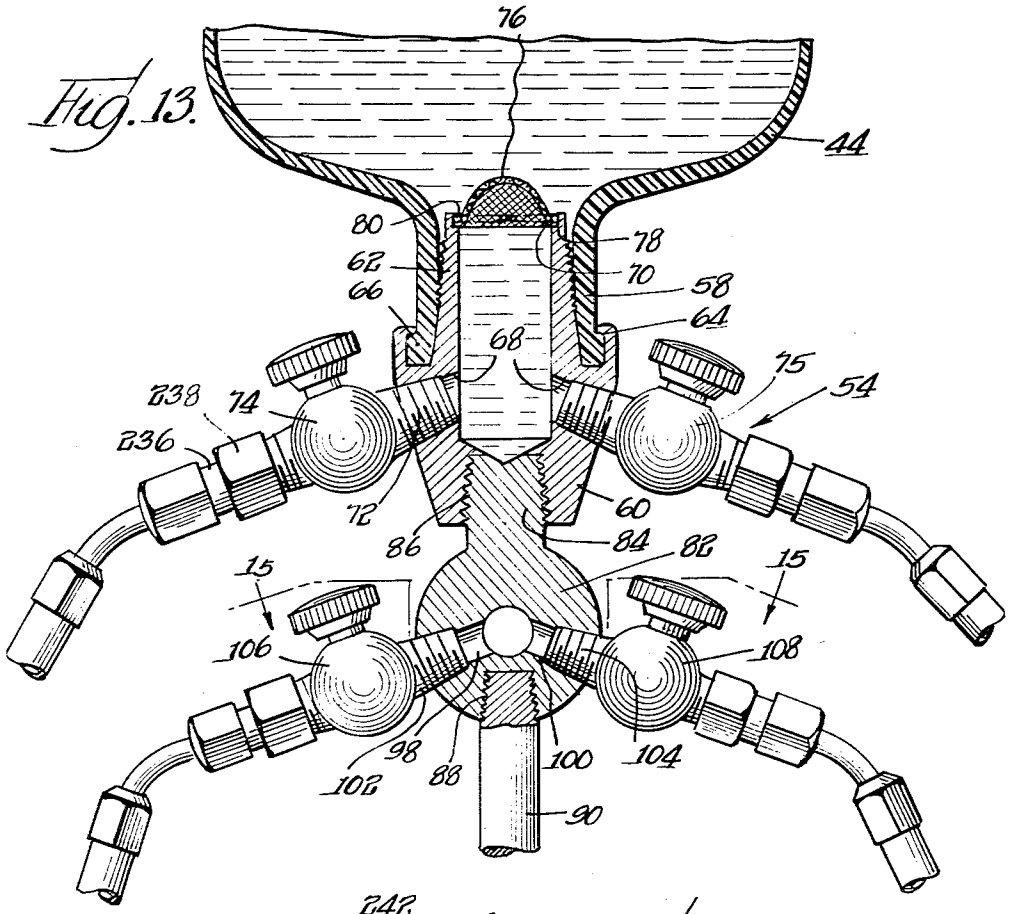


Fig. 14.

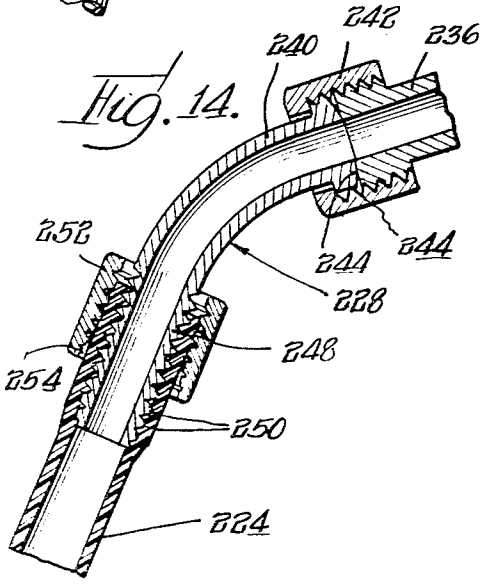
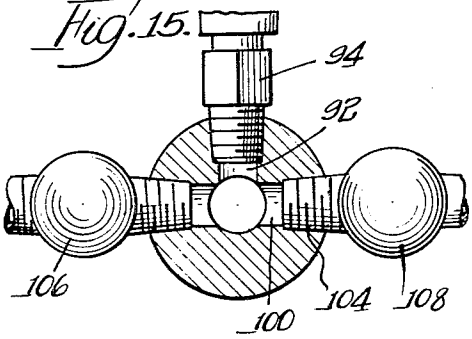


Fig. 15.



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COOLING METHOD AND APPARATUS FOR METAL WORKING

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Fig. 16.

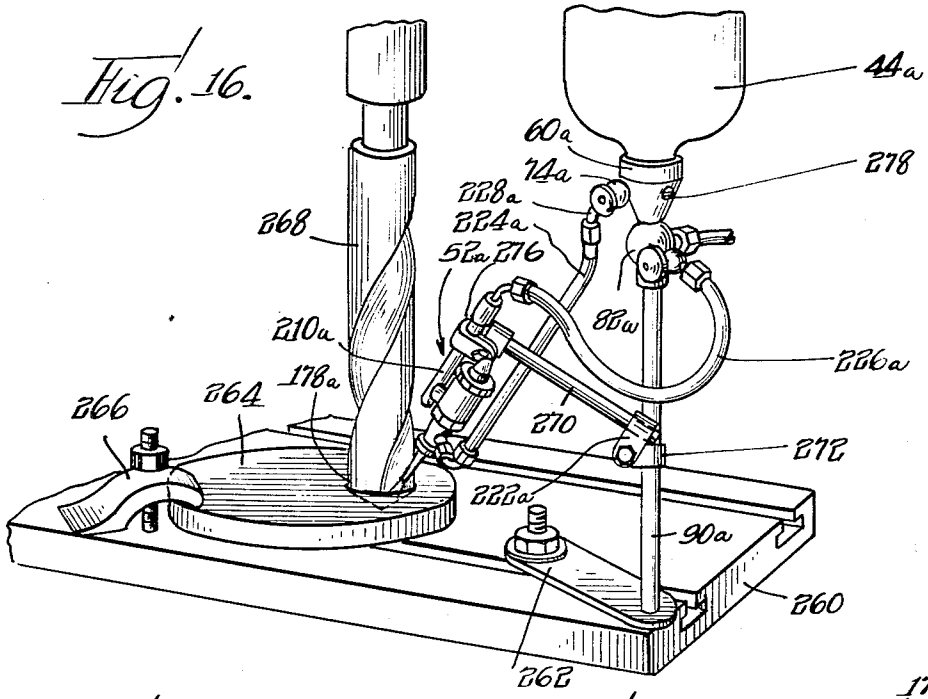


Fig. 17.

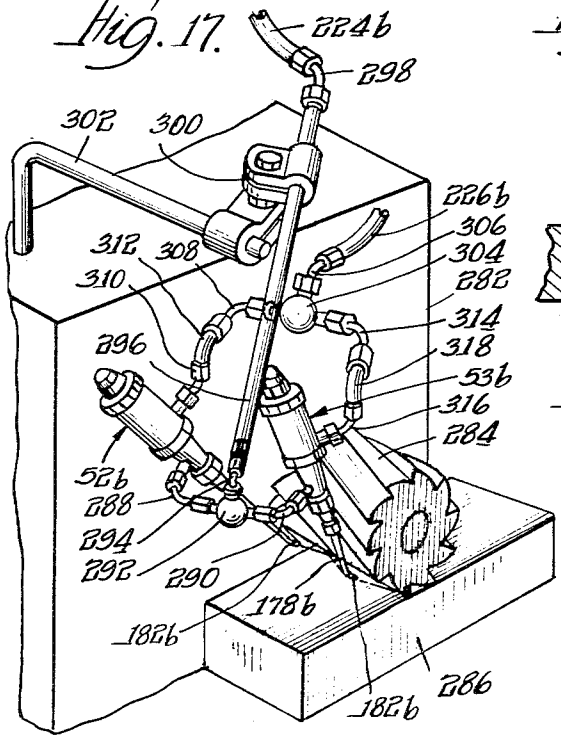


Fig. 18.

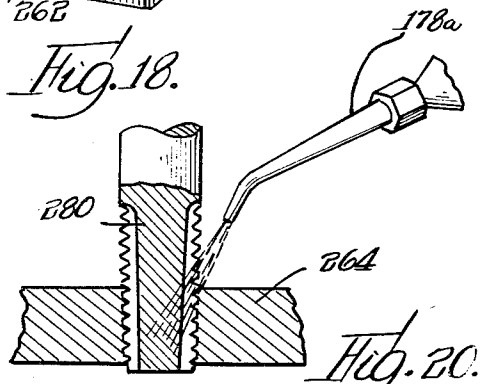
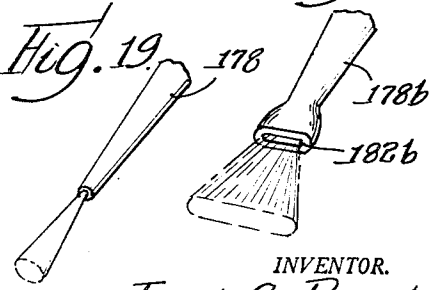


Fig. 20.

Fig. 19.



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COOLING METHOD AND APPARATUS FOR METAL WORKING

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Fig. 21.

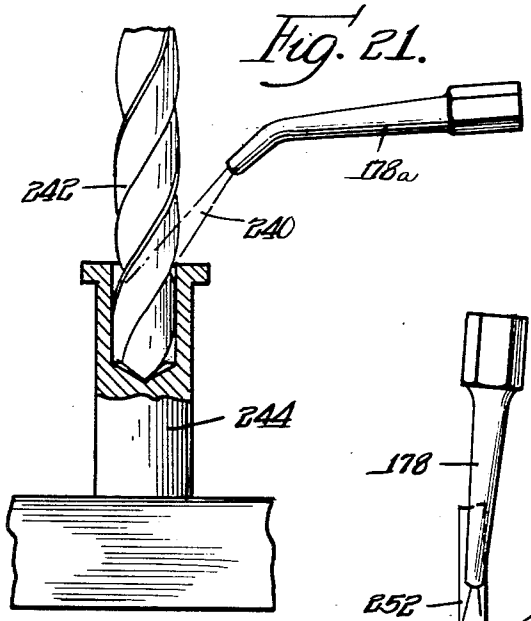


Fig. 22.

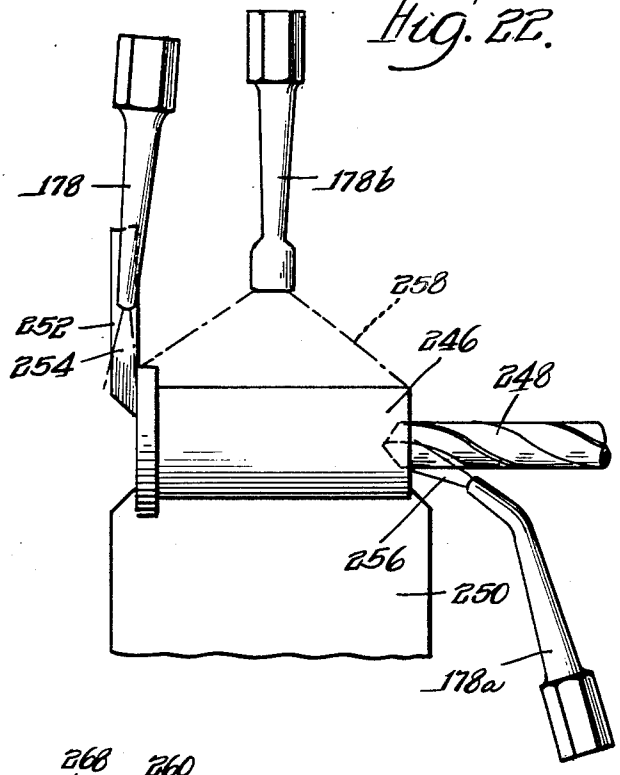
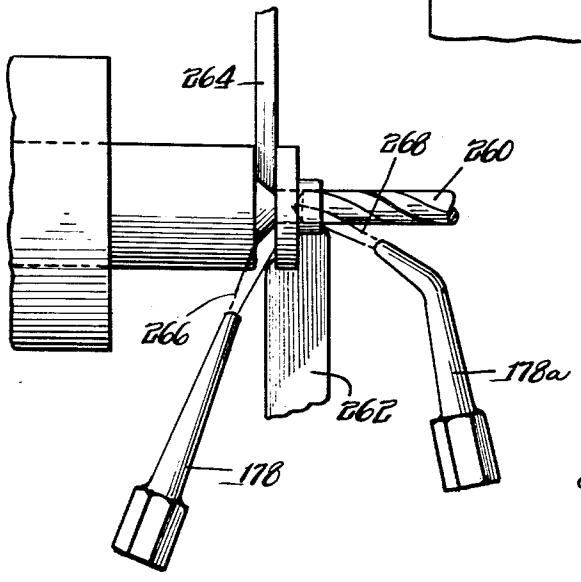


Fig. 23.



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United States Patent Office

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COOLING METHOD AND APPARATUS FOR METAL WORKING

Jens A. Paasche, Chicago, Ill., assignor, by mesne assignments, to The Paasche Company

Application March 3, 1955, Serial No. 491,977

2 Claims. (Cl. 239—273)

The present invention relates to a novel apparatus for use in connection with substantially all types of metal working machines, power saws and grinding machines for cooling the tools, saw blades and grinding wheels as well as the work.

It has long been the general practice in many metal forming or cutting operations to direct a stream of cooling liquid or cooling oil over the work and tool to flood the area around the point of contact between the tool and work for cooling purposes. Such prior systems are subject to several disadvantages and, in addition, frequently fail to provide the most effective cooling action. For example, in many installations using prior cooling systems, the liquid coolant is continuously splashed over the machine, the operator and the surrounding floor area so that large amounts of the coolant are lost and considerable labor must be expended to keep the machine and floor clean. Furthermore, some means must be provided for reclaiming the cooling liquid which is normally collected along with scrap and chips from the workpiece, which reclaiming requires the use of considerable apparatus and labor and seldom can be carried out sufficiently to prevent the loss of a substantial amount of cooling liquid.

An important object of the present invention is to provide a novel apparatus to be used in connection with metal working or cutting machines for cooling the workpiece and cutting tool more efficiently so as to permit substantial increases in the rate of metal working and to prolong the life of the metal working tool, whereby workpieces may be more rapidly and economically produced.

A more specific object of the present invention is to provide a novel apparatus of the above described type which utilizes relatively small amounts of a cooling liquid so that the loss of cooling liquid for a given operation is reduced.

Still another object of the present invention is to provide a novel apparatus of the above described type which delivers relatively small amounts of cooling liquid in atomized form in a manner so that the necessity for reclaiming the liquid is eliminated and so that the metal working machine, the operator, and the surrounding floor area will not become covered by the liquid whereby cleaning costs may be substantially reduced.

Still another object of the present invention is to provide a novel apparatus or unit of the above described type which is substantially self-contained and which may be easily mounted on various standard metal working machines such as turret lathes, automatic screw machines, milling machines, planers, drill and tapping machines, power saws, grinding machines and the like.

Another more specific object of the present invention is to provide a novel apparatus or self contained unit of the above described type which will automatically start and stop delivery of coolant upon starting and stopping of the metal working machine.

Other objects and advantages of the present invention will become apparent from the following description and the accompanying drawings wherein:

Fig. 1 is an elevational view showing a unit embodying the principles of this invention mounted on a turret lathe;

Fig. 2 is a fragmentary perspective view of a portion of the assembly shown in Fig. 1;

Fig. 3 is an enlarged fragmentary sectional view taken along line 3—3 in Fig. 1;

Fig. 4 is a longitudinal sectional view of a novel atomizer gun utilized in the apparatus of this invention;

Fig. 5 is a cross sectional view taken along line 5—5 in Fig. 4;

Fig. 6 is a cross sectional view taken along line 6—6 in Fig. 4;

Fig. 7 is a cross sectional view taken along line 7—7 in Fig. 4;

Fig. 8 is a perspective view showing one form of the jet nozzle tip adapted to be connected with the atomizer gun;

Fig. 9 is an exploded perspective view showing another jet nozzle tip assembly;

Figs. 10, 11 and 12 are longitudinal sectional views of various jet nozzle tips formed in accordance with the present invention;

Fig. 13 is an enlarged sectional view showing a portion of the cooling liquid supply reservoir and the assembly for distributing cooling liquid and compressed air to a plurality of automatic atomizing guns;

Fig. 14 is an enlarged fragmentary sectional view showing the manner in which a flexible plastic hose is connected with the distributor assembly;

Fig. 15 is a fragmentary sectional view taken along line 15—15 in Fig. 13;

Fig. 16 is a fragmentary perspective view showing a unit embodying the principles of this invention mounted on a drill press;

Fig. 17 is a fragmentary perspective view showing another unit embodying the principles of this invention mounted on a milling machine;

Fig. 18 is a fragmentary sectional view showing how coolant may be directed by the apparatus of this invention against a tapping tool;

Fig. 19 is a perspective view showing the jet nozzle tip and the shape of the atomized jet delivered thereby;

Fig. 20 is a fragmentary perspective view showing another jet nozzle tip and a shape of the atomized jet delivered thereby; and

Figs. 21, 22 and 23 show the manner of impinging jets of atomized coolant and compressed air against the work and tools in various installations.

Referring now more specifically to the drawings wherein like parts are designated by the same numerals throughout the various figures, a cooling unit 30 embodying the principles of this invention is shown in Figs. 1 and 2 mounted on a turret lathe 32 of known construction. As will be understood, the turret lathe includes a rotatable chuck 34 adapted to carry a workpiece 36, an indexing turret 38 carrying a plurality of tools 40, and an operating handle 42 which is actuated back and forth upon starting and stopping of the machine. The cooling apparatus or unit 30 includes a reservoir 44 for a supply of liquid coolant, an air pressure regulator 46 adapted to be connected with any suitable source of air under pressure, not shown, by a hose 48, an air control valve 50, one or more atomizing jet guns 52 and 53, and means 54 for distributing the liquid coolant and air under pressure to the jet cool guns.

The reservoir 44 is in the form of an inverted bottle having a removable cover 56 to permit filling thereof. The bottle is formed from a clear or translucent material

so that an operator may readily observe the supply of cooling liquid contained therein. Preferably, the bottle is formed from a plastic material so as to eliminate any problem of breakage.

The lower end of the bottle 44 is provided with a neck 58 which is connected with a member 60 of a distributor assembly. The member 60 has a hollow shank portion 62 threaded into the bottle neck and a deformable annular flange portion 64 adapted to receive and to be swaged over a flange 66 at the end of the bottle neck positively to secure the bottle and the member 60 against accidental separation. The member 60 is provided with a plurality of circumferentially spaced and downwardly inclined liquid passageways 68 which intersect its central bore 70. Into each of these downwardly inclined passageways, there is threaded a nipple 72 of shut-off valves 74 and 75, each of which shut-off valves is connected with a separate atomizing gun as will be described below. In order to prevent any contaminating particles in the liquid coolant from passing to and clogging the atomizing guns, a dome-shaped filter 76 is provided. This filter is mounted on an annular seat 78 formed in the upper end of the threaded shank portion 62 and is retained in position by a snap ring or the like 80. While the member 60 is disclosed as being formed for distributing cooling liquid to a pair of atomizing guns, it is contemplated that this member may be formed and means may be provided for distributing liquid to a different number of atomizing guns.

The distributor assembly 54 also includes a member 82 for directing air under pressure to a plurality of atomizing guns, which member has a solid nipple 84 threaded into an aperture 86 in the lower end of the member 60. In addition, the member 82 is provided with a threaded aperture 88 into which the upper end of a support or standard 90 may be inserted for mounting both the reservoir and the distributor assembly. The standard 90 is, in turn, mounted on the machine tool or turret lathe or to any suitable support structure, not shown, adjacent the machine tool. The member 82 is provided with an air passageway 92 into which a fitting 94 on an end of an air hose 96 is threaded. The air hose 96 is also connected with the control valve 50, as will be described below. In the particular embodiment illustrated the member 82 is also provided with a pair of circumferentially spaced passageways 98 and 100 which intersect the passageway 92. Nipples 102 and 104 of shut-off valves 106 and 108 are threaded into the passageways 98 and 100, respectively, which valves are connected with separate atomizing guns. It is apparent that the member 82 may also be modified for distributing air to a different number of atomizing guns.

The air pressure regulator 46 and the control valve 50 are preferably mounted together in a single assembly and may be supported by any suitable means such as a bracket 110 secured to the side of a machine tool. The air pressure regulator 46 may be of any known construction and, therefore, need not be described in detail, and it suffices to state that the air pressure regulator is of the type which may be adjusted so as to reduce the pressure of the air supplied thereto through the line 48 any desired amount. For use in the apparatus of the present invention the pressure regulator 46 will usually be adjusted so that air is directed therefrom through a conduit 112 to the control valve at pressures between about 30 to 60 p.s.i. Normally the lower of these pressures are preferred to prevent waste of air and coolant, but when hard stock is being cut so that a large amount of heat is generated, it will be necessary to use higher pressures in this range.

As shown best in Fig. 3, the control valve 50 includes a body 114 having a central bore or air passageway 116 therein which is intersected by lateral ports 118 and 120. These ports are respectively adapted to be connected with the conduit 112 and the air hose 96 through suitable coupling devices. A valve stem 122 is slidably disposed in the bore 116 and is normally resiliently urged by a spring 124 to a position for shutting off the air under pressure from the port 120 and thus, from the distributor assembly and atomizing gun. A swivel lever 126 is pivotally mounted for engaging an end of the valve stem 122, which lever carries a roller 128, engageable with an end 130 of the operating handle 42 of the machine tool. The arrangement is such that when the operating handle 42 is shifted upon starting of the machine tool, the lever 126 is pivoted against the valve stem 122 to shift the valve stem to an open position. Furthermore, when the operating handle 42 is shifted back to its original position upon stopping of the machine tool, the spring 124 functions to shift the valve stem back to the closed position. Thus, the air under pressure is automatically supplied to and shut off from the atomizing guns upon starting and stopping of the machine tool.

All of the guns are identical and, therefore, only the atomizing gun 52, which is shown in detail in Figs. 4 through 7, need be described. The atomizing gun 52 includes a main body member 132 and a hollow body portion 134 which is connected to the body member 132 by a fitting 136 threaded into an aperture 138 and drawn against the body member 132 by a nut member 140. The body member 132 is provided with a central chamber 142 to which the cooling liquid is directed through a lateral passageway 144 formed in a nipple 146. An internal nozzle 148 is threaded into the end of the body member 132 and communicates with the chamber 142, and this nozzle has a restricted outlet orifice 150. Passage of the liquid coolant through the orifice 150 is controlled by a needle valve 152 in the manner described below.

Air under pressure is supplied to a hollow nipple 154 by means described below and passes through a port 156 into a chamber 158 within the hollow body portion 134. A plurality of passageways 160 is formed in the fitting 136 for directing the air under pressure from the chamber 158 to an annular chamber 162 from where the air passes through a plurality of passageways 164 which are shown in Figs. 4 and 6. An external nozzle 166 is secured to the end of the body member 132 by a nut member 168, and the air passes from the passageway 164 into an annular chamber 170 provided between the nozzle 166 and the end of the body member 132. The nozzle 166 has a tip portion 172 having a restricted orifice therein which is slightly larger than the tip portion of the nozzle 148, and, as shown in Figs. 4 and 5, the nozzle 166 is provided with a plurality of passageways 176 connecting the chamber 170 and the restricted orifice 174. An elongated nozzle tip 178 is threaded onto the tip of the nozzle 166 for directing the spray of air and coolant to a point of discharge adjacent the work. As shown in Figs. 4 and 10, the tip of the nozzle 148 terminates well within the aperture of the nozzle tip 172, and the elongated nozzle tip 178 has a central passageway 180 with a diameter less than the diameter of the aperture 174 and a restricted discharge orifice 182. With this novel arrangement the liquid coolant is broken up into small particles as it enters the relatively large aperture 174 from the restricted orifice 150 under gravity and syphon feed whereupon the air and atomized liquid is compressed as it enters the elongated passageway 180 and is rapidly expanded as it leaves the discharge orifice 182 and impinges against the work. The restricted elongated passageway and orifice 182 promote efficient syphoning of the coolant into the chamber 174 so that a highly concentrated air coolant mixture is formed.

It has been found that by directing an expanding jet of compressed air and atomized liquid against the work in accordance with the present invention much more efficient cooling of the workpiece is obtained as compared with cooling systems heretofore in general use. Tests have shown that as a result of this more efficient cooling, production of workpieces such as certain shafts, for example, may be increased by about 140%. Furthermore,

many workpieces are cooled to such an extent that they may be immediately picked up in the hand of the operator so that handling of such workpieces is greatly facilitated. It should be noted that this very efficient cooling is obtained with small amounts of the finely atomized liquid coolant, which amounts may be on the order of one drop per second, whereby savings in the amount of the liquid coolant used may be effected and whereby the coolant actually used is substantially completely absorbed by the workpiece. As the result of this latter factor, the machine, operator, and surrounding floor area are not splattered or covered with the liquid coolant so that a considerable amount of the time and labor formerly expended to maintain the machine and floor clean is saved and costly pumps and machine parts heretofore used to recover the coolant are also eliminated.

The needle valve **152** is connected to or made integral with a stem **184** which extends through packing means **186** and into the hollow body portion **134**. A piston assembly **188** is fixed on the valve stem, and a compression spring **190** acts between the piston and a cap **192** threaded onto the hollow body portion for yieldably biasing the needle valve toward the left as viewed in Fig. 4 to close the restricted orifice **150** and stop the flow of cooling liquid. When the above described control valve is actuated to admit air under pressure to the atomizing gun, the air entering the chamber **158** acts against the piston and forces the piston and the needle valve toward the right against the action of the spring **190** so as to open the orifice **150** and permit the flow of cooling liquid. In order to control the rate at which liquid may flow through the orifice **150**, means is provided for limiting the amount which the needle valve may be opened. This means includes a stop pin **194** threaded to an apertured boss **196** on the cap **192** and having an inner end disposed for engagement with the valve stem **184** to limit movement thereof. A hollow nut-like member **198** is threaded on the stop pin **194** and is locked or jammed against rotation relative to the stop pin by a cap nut **200**. Thus, the stop pin **194** may be adjusted axially relative to the valve stem by turning the nut member **198** which, in turn, causes turning of the stop pin. The nut member **198** is knurled or provided with ribs as at **202** to facilitate easy hand turning thereof. A compression spring **204** is provided between the cap **192** and the nut member **198** for locking the nut member and stop pin in any desired adjusted position. A pointer **206** is provided on the nut member **198**, which pointer cooperates with numerals or graduations **208** on the periphery of the cap member **192** to indicate the position to which the stop pin **194** is adjusted and, thus, providing micrometer readings of fluid control.

In order to facilitate mounting of the atomizing gun **52** in the desired position with respect to the work, an air pipe section **210** is joined with the air inlet nipple **154** by a swivel connection. As shown best in Fig. 4, the pipe section **210** has a closed end **212** and a laterally extending fitting **214** is secured to the pipe section adjacent the closed end. The fitting has a rounded end **216** adapted to seat against the end of the nipple **154**, and a nut member **218** is provided for drawing the rounded end of the fitting into sealing engagement with the seat. It will be appreciated that the spray gun may be twisted relative to the pipe section **210** easily after the nut member **218** has been loosened, and after the spray gun has been adjusted to the desired position, the connection between the pipe section in the atomizing gun may again be sealed by tightening the nut. The atomizing gun **54** is mounted on the machine tool in any desired location adjacent the work by means of a support rod **220** and an adjustable clamp **222** gripping both the support rod **220** and the pipe section **210**. The atomizing gun **53** is similarly mounted and this mounting need not be described in detail.

The atomizing gun **52** is connected with the distributor assembly **54** by flexible hoses or conduits **224** and **226**. More specifically, the conduit **224** extends between the valve assembly **74** and the inlet nipple **146** on the atomizing gun, and the conduit **226** extends between the valve assembly **106** and the air pipe **210**. The conduit **224** is preferably made from a clear plastic material so that an operator may readily see that a supply of the liquid coolant is available to the spray gun. This is important since the jet discharged by the gun against the work contains so little of the liquid coolant that it is almost invisible. Coupling assemblies **228** and **230** are provided for connecting the conduit **224** to the valve **74** and nipple **146**, respectively, and similar coupling assemblies **232** and **234** are provided for connecting the conduit **226** to the valve **106** and the pipe **210**, respectively. In Fig. 14 the coupling assembly **228** is shown in detail to illustrate the manner in which the ends of the flexible plastic conduits are connected with the coupling assemblies in a secure and sealed manner. The coupling assembly **228** includes a fitting **236** which is connected to the valve member **74** by a nut **238**. A short tube **240** is connected with the fitting **236** by a nut member **242**, and the tube **240** and the fitting are provided with mating surfaces **244** and **246** which provide a seal. The opposite end of the tube **240** is provided with helical screw threads **248** of considerable axial extent. It should be noted that the screw threads **248** decrease in height toward the end of the tube **240** and are provided with flat crests as indicated at **250**. This arrangement provides the tube **240** with a tapering end over which the plastic conduit **224** may be easily slipped, and the flattened crests of the endmost screw threads eliminate any danger of cutting the plastic conduit. After the end of the plastic conduit has been slipped over the threads on the tube **240**, a nut member **252**, which has an internal diameter substantially greater than the external diameter of the tube **240**, is slipped along the tube **240** and threaded over the end of the plastic conduit to the position shown in Fig. 14. It should be noted that the threads of the nut member adjacent the leading end thereof decrease in height so as to provide the nut member with a flared mouth **254** to facilitate initial application of the nut member over the end of the plastic conduit. It should be also noted that the internal diameter of the nut member is sufficiently small to cause a portion of the teeth **248** on the tube **240** to be embedded in the plastic conduit without cutting entirely through the plastic conduit. Furthermore, since the mouth of the nut member is flared and since the outer endmost threads on the tube **240** are tapered, the axially spaced threads on the tube will dig into the plastic conduit different amounts. With this arrangement a secure connection between the plastic conduit and the tube **240** is insured while at the same time, any danger of leakage developing as a result of cutting of the plastic conduit is eliminated.

In Fig. 16 there is shown a slightly modified form of the novel apparatus or unit of this invention which is similar to the above described apparatus as indicated by the application of identical reference numerals with the suffix "*a*" added to corresponding elements. This embodiment differs in that it includes only a single atomizing gun and in that it is especially adapted for mounting on a drill press. More specifically, the standard **90***a* which supports the reservoir and distributor assembly is mounted on the bed **260** of a drill press by any suitable bracket means **262**. The standard is mounted adjacent a workpiece **264** which is held by clamping means **266** beneath a drill **268**. In order to support the atomizing gun **52***a*, a rod **270** is adjustably secured to the standard **90***a* by clamp means **222***a* having pivotally connected sections **272** and **274**, respectively, gripping the standard **90***a* and the rod **270**. Similar adjustable clamp means **276** connects the rod **270** with the pipe section **210***a* of the atomizing gun. Since only one spray gun is being used, one of the

lateral distributing passageways in the distributor member **60***a* is closed by a plug **278** and one of the lateral passageways in the distributor member **82***a* is closed by a similar plug, not shown. In order to direct the spray generally axially into the hole being drilled into the workpiece, the elongated nozzle tip **178***a* has an end portion thereof bent laterally about 45° as shown in Figs. 8 and 16. This modified form of the nozzle is also shown in Fig. 18 wherein it is arranged for directing the spray into an aperture in the workpiece **264** which is being finished with a tapping tool **280**.

Fig. 17 shows a portion of another unit embodying a modified form of the present invention, which unit is similar to the above described structures as indicated by the application of identical reference numerals with the suffix "*b*" added to corresponding elements. This embodiment is especially adapted for application to a milling machine **282** for directing a plurality of sprays along a broad milling cutter **284** acting upon a workpiece **286**. In this embodiment the liquid coolant inlet nipples of the spray gun **52***b* and **53***b* are respectively connected by coupling devices **288** and **290** to a distributing member **292**, which distributing member is, in turn, connected by a coupling device **294** with one end of a pipe section **296**. The opposite end of the pipe section **296** is connected to the flexible hose **224***b* by a coupling device **298**. In addition, the pipe section **296** is utilized for supporting the atomizing guns and, more particularly, this pipe section is connected by adjustable clamp means **300** similar to the above described adjustable clamp means to a horizontal portion of a support rod **302** mounted on the milling machine. With this arrangement, it will be appreciated that atomizing guns may be adjusted horizontally, vertically and longitudinally relative to the milling cutter. In this embodiment, the air conduit **226***b* is connected with a distributor member **304** by a coupling device **306**, which distributor member is, in turn, connected with the air inlet nipples of the spray guns. More specifically, one outlet port of the distributor member **304** is connected with the air inlet nipple of the gun **52***b* by coupling devices **308** and **310** and an intermediate tube **312** and the outer outlet of the distributor member **304** is connected with the gun **53***b* by coupling devices **314** and **316** and an intermediate tube **318**. In order to distribute the coolant uniformly along the relatively broad surfaces of the milling cutter and the workpiece, the elongated nozzle tips **178***b* are formed with a wide flat discharge orifice **182***b* as shown best in Figs. 12 and 20.

In some installations it may be possible to arrange the spray guns so that the discharge end of the elongated nozzle tip **178** or the coresponding above described elongated nozzle tips will be close enough to the work, and in such cases, extension nozzle tips of the type shown in Figs. 9 and 11 may be provided. More specifically, in Fig. 9, a tip extension **320** is shown which has an enlarged tapered bore portion **322** so that it may be slipped over and jammed on a tapered end portion **324** of the nozzle tip **178**. The tip extension **320** also is provided with a section **326** having an external polygonal shape to facilitate turning of the tip extension and removal thereof from the nozzle tip **178**. This polygonal section is disposed between the ends of the tip extension to facilitate machining of the extension. The particular nozzle tip extension shown in Fig. 9 is provided with a relatively wide and flat discharge orifice **328** similar to the above described orifice **182***b* so that it is particularly adapted for use with tools having relatively broad cutting edges. Also, this particular tip extension is shown as having an angularly bent end portion similar to the angularly bent end portion of the above described nozzle tip **178***a*, but it is understood that the tip extension **320** may also be formed straight. For example, in Fig. 11, there is shown a straight nozzle tip extension **330** having an enlarged bore portion **332** so that it is adapted to be assembled with the above described nozzle tip **178**. This nozzle tip extension is provided with an elongated passageway **334** which corresponds to the above described passageway **180** through the nozzle tip **178**, and a restricted outlet orifice **336** which corresponds to the above described outlet orifice **182**.

Figs. 21, 22 and 23 show in greater detail how the cooling jets should be impinged against the work and tools in various installations. Fig. 22 shows how a nozzle tip **178***a* should be arranged to direct a jet **240** against a drill **242** and into the aperture in a workpiece **244**. Fig. 22 shows an installation wherein a workpiece **246** is to be acted upon a drill **248**, a forming tool **250**, and a cutting tool **252**, and further shows how nozzle tips **178**, **178***a* and **178***b* should be arranged to impinge jets **254**, **256** and **258** against the tools and workpiece. Fig. 23 shows another installation wherein a workpiece is to be acted upon by a drill **260**, a forming tool **262**, and a cutting tool **264**, and wherein nozzle tips **178** and **178***a* are positioned to direct jets **266** and **268** against the work and tools.

The above described novel cooling apparatus or unit may be mounted and operated as follows. The reservoir and distributor assembly are mounted on or adjacent the machine tool and above the cutting station as shown in Fig. 1 so that the cooling liquid will be fed to the spray guns by gravity. The air control valve is mounted at any convenient location so that they will be actuated by the machine operating handle in the manner described above. Then the atomizing guns are mounted and adjusted so that the discharge ends of the nozzle tips or the tip extensions are located at a distance of one-half to two inches from the cutting edge of the tool. Then the air pressure regulator is adjusted so that a gauge reading of between 30 and 60 p.s.i. will be obtained. In addition, the needle valve control on each spray gun is adjusted to obtain the desired rate of liquid coolant flow which usually should be about one drop per second and may be between about one-half to two drops per second. Then upon starting of the machine tool in the usual manner, the air cntrol valve is opened so that air under pressure is distributed to atomizing guns. The air under pressure opens the needle valve in the manner described above so that the liquid coolant is allowed to flow into the air stream wherein it is atomized and delivered to the work in the manner described above.

From the above description it is seen that the present invention has provided a novel apparatus or unit which is capable of fully satisfying the objects heretofore set forth. More specifically, it is seen that the present invention has provided a unit which may be easily mounted on various machine tools and adjusted to fill the requirements of the particular work forming operation. It should be noted that while the present apparatus has been primarily described in connection with the use on machines utilizing cutting tools and the like, it is also useful with other machine tools, power saws, grinding machines and the like. From the above description it is also seen that the present invention has provided an apparatus which is capable of delivering an expanding and highly concentrated air jet and atomized coolant mixture producing more efficient cooling at great savings. Furthermore, it will be appreciated that the problems of handling and cleaning finished workpieces and of cleaning the machine tools and surrounding work area are minimized when the apparatus of this invention is used.

While the preferred embodiments of the present invention have been shown and described herein, it is obvious that many structural details may be changed without departing from the spirit and scope of the appended claims.

The invention is claimed as follows:

1. A self-contained unit adapted to be mounted in association with a material working machine for cooling an area of contact between a material working element of the machine and a work piece, said unit com-

prising means defining a mixing chamber for atomized liquid coolant and air under pressure, first supply means including a first conduit for delivering air under pressure to said mixing chamber, second supply means including a reservoir and a second conduit having a restricted orifice for delivering liquid coolant to said mixing chamber in atomized form, a third conduit connected to said mixing chamber and serving as a discharge from said mixing chamber and having an elongated portion having transverse dimension less than the transverse dimension of said mixing chamber for directing the streaming suspension of said atomized coolant in air under pressure formed in said mixing chamber against said area of contact, said third conduit having a restricted discharge orifice whereby said suspension of atomized coolant in air is suddenly expanded immediately before impingement against said area of contact, said first supply means comprising a first distributor member having an inlet passageway and a plurality of outlet ports, said first supply means also comprising an air conduit for each inlet port, said second supply means comprising a second distributor member connected with and supported by said first distributor member and also connected with and supporting said reservoir and having an inlet passageway and a plurality of outlet ports, said second supply means also comprising a coolant conduit having a restricted orifice for each of its outlet ports, and said unit comprising a mixing chamber and a mixing chamber discharge conduit for each pair of air and coolant conduits.

2. A self-contained unit adapted to be mounted in association with a material working machine for cooling an area of contact between a work piece and a material working element of the machine, said unit comprising means defining a mixing chamber for atomized liquid coolant and air under pressure, first supply means including a first conduit for delivering air under pressure to said mixing chamber, second supply means including a reservoir and a second conduit having a restricted orifice for delivering liquid coolant to said mixing chamber in atomized form, and a third conduit serving as a discharge from said mixing chamber and having a transverse dimension less than the transverse dimension of said mixing chamber for directing the streaming suspension of said atomized coolant in air under pressure in the mixing chamber against the said area of contact, said third conduit having a restricted discharge orifice whereby said suspension of atomized coolant in air is suddenly expanded immediately before impingement against said area of contact, said first supply means comprising a valve in said first conduit, means actuated by the starting and stopping of said machine, respectively, to open and close said valve and means for normally preventing flow of liquid coolant into said mixing chamber, said last mentioned means being responsive to air under pressure flowing through said valve to permit flow of liquid coolant into said mixing chamber.

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UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 2,929,566 March 22, 1960

Jens A. Paasche

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 7, line 49, after "may" insert -- not --; line 51, for "coresponding" read -- corresponding --; column 8, line 12, after "upon" insert -- by --.

Signed and sealed this 30th day of August 1960.

(SEAL)
Attest:

ERNEST W. SWIDER
Attesting Officer

ROBERT C. WATSON
Commissioner of Patents