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AIR BLAST LUBRICATOR FOR DRILLS

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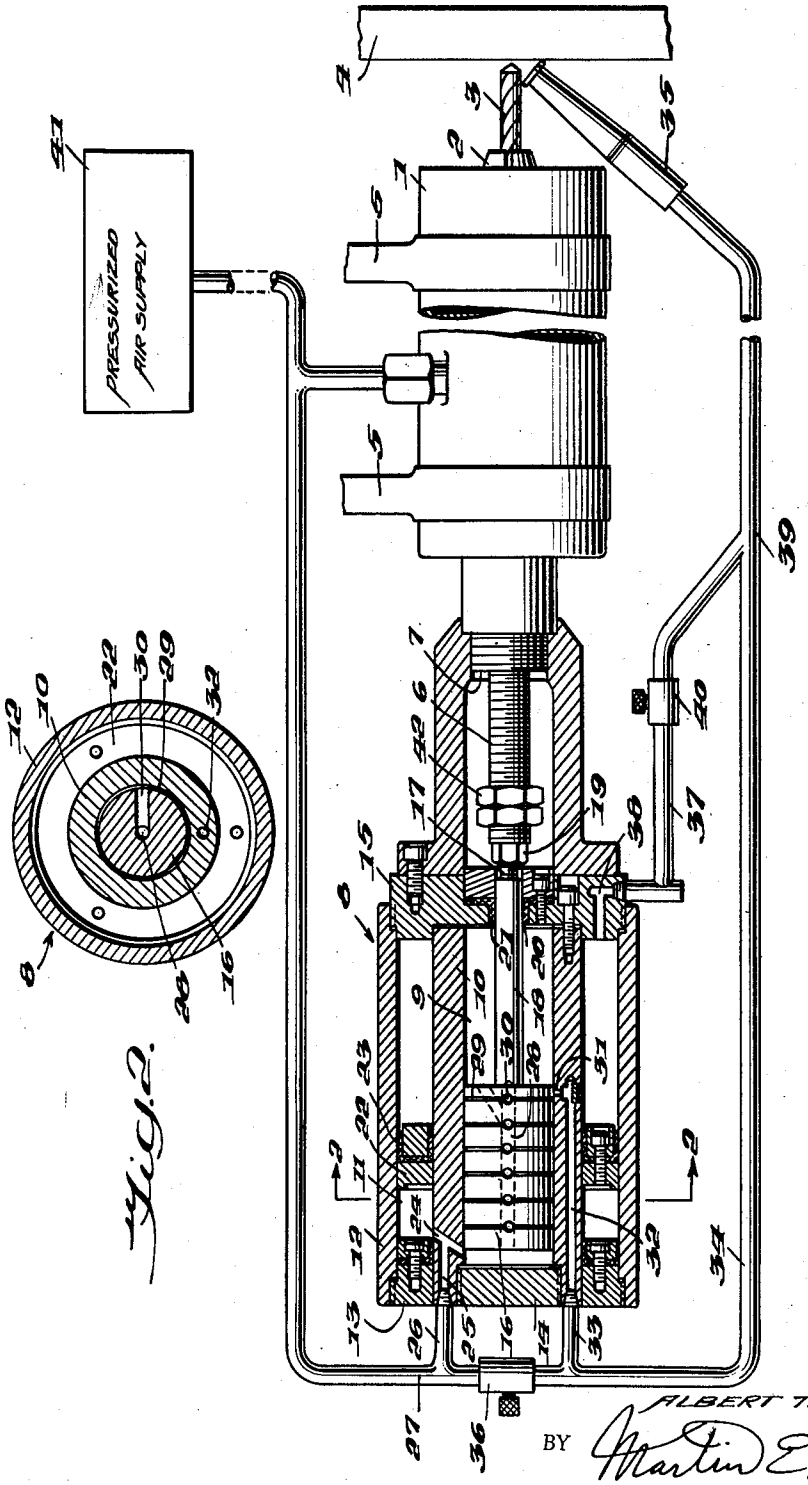


Fig. 1.

Fig. 2.

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AIR BLAST LUBRICATOR FOR DRILLS

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This invention relates to an automatic lubricating and chip removing device for a machine tool and more specifically to such a device for use with drilling machines, particularly those machines adapted to automatically feed the drill into the work as the drilling operation progresses. When drilling most materials, provision must be made to deliver a lubricant to the cutting edges of the drill to insure proper cutting action. In addition, if accuracy in drilling and a high quality finish on the wall of the hole being drilled is desired, it is necessary to remove the chips formed by the cutting action of the drill. In some applications, the lubricant is directed at the drill in quantity to simultaneously lubricate the drill and wash away the chips. This method, however, does not always provide satisfactory chip removal and is extremely wasteful of lubricant. Chip removal has also been attempted by sucking the chips away through a tube through which air is drawn by suitable means. While this method is sometimes effective for dry chips produced by drilling operations in which no lubricant is required, it is not satisfactory when a lubricant is used since the chips, when wet with a lubricant, tend to cling to the drill and the portion of the work surrounding the drilled area, and it is difficult to produce, by suction means, sufficient air velocity past the chips to dislodge them.

Extremely effective chip removal may be obtained by directing a blast of air at the drilled area, but because of the above mentioned tendency of the chips to cling to the drill and the work in the presence of a lubricant, an air blast of high velocity is necessary to remove them.

This blast of high velocity air will, however, blow the lubricant away from the drill. An additional disadvantage lies in the fact that if a number of drills are being simultaneously supplied from a single source, the total air requirement to provide a continuous blast of high velocity air would necessitate a source of supply of very large capacity.

To overcome the above stated objections, the present invention provides a method for lubricating the drill by continuously introducing lubricant into an air stream having a velocity only sufficient to carry the lubricant to the drill, and augmenting this stream of low velocity air and lubricant by a series of intermittent high velocity air blasts from the same air source to effect satisfactory chip removal. Since the lubricant is continuously delivered to the drill by the air stream even during the high velocity blasts, satisfactory lubrication at all times is obtained, and since the high velocity blasts are of short duration, the capacity requirement of the air source is comparatively small.

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It is the object of this invention, therefore, to provide an automatic lubricating and chip removing device which will provide continuous lubrication of a drill while simultaneously providing effective removal of the chips formed during the drilling operation.

It is another object of this invention to provide a method for removing chips produced by a drilling operation by the use of high pressure air blasts, without interfering with the delivery of lubricant to the drill.

It is still another object of this invention to provide a device for continuously delivering a predetermined quantity of lubricant to a drill while simultaneously directing an air blast at the drill of sufficient strength to carry away the chips produced by the drilling operation.

It is a further object of this invention to provide means for directing from a nozzle a quantity of lubricant entrained in air while simultaneously emitting from the same nozzle intermittent blasts of high pressure air to remove the chips produced by the drilling operation.

These and further objects of this invention will become apparent from the following description taken in connection with the accompanying drawings.

In the drawings:

Figure 1 is a partial sectional view showing the invention adapted to a conventional air operated drill with the operating portions of the invention shown in cross section.

Figure 2 is a sectional view taken along line 2—2 of Fig. 1.

Referring to Fig. 1, there is shown an automatic drilling machine 1 operated by pressurized air from a source of supply 41, and having a rotating chuck 2 at its forward end which holds a twist drill 3. The drilling machine 1 is of a conventional type which automatically advances the drill 3 into the work 4 during the drilling operation. Brackets 5 serve to attach the machine to suitable supporting structure (not shown). This type of drilling machine is equipped with a threaded stud 6 which extends from the aft end of the machine and is internally connected to the operating mechanism thereof so as to move axially with the drill as it advances during the drilling operation. A pair of adjustable lock nuts 42 carried by the stud 6 serve to limit the forward travel of the drill 3 by striking

the rear end 7 of the casing of the drilling machine 1.

A dual cylinder assembly, indicated generally at 8, comprises an inner cylinder 9 enclosed by inner cylinder wall 10, and on outer annular cylinder 11, formed by the annular space between inner cylinder wall 10 and outer cylinder wall 12. The outer cylinder head 13 forms the rearward wall of outer cylinder 11 and inner cylinder head 14 closes off the rearward end of inner cylinder 9. A forward cylinder head 15 forms the forward end of both the inner and outer cylinders. A sliding piston 16 contained within inner cylinder 9 is connected to the aft end of threaded stud 6 by means of the threaded portion 17 at the forward end of piston rod 18 which extends from the forward end of piston 16 and is integral therewith. Nut 19 serves to lock the connection between piston rod 18 and stud 6. A sealing ring 20 encircling piston rod 18 is provided to form an airtight seal at the opening 21 in cylinder head 15 through which piston rod 18 passes. An annular piston 22, slidably contained within outer cylinder 11 carries a sealing ring 23 which forms an air- and oil-tight seal between the portion of cylinder 11 forward of piston 22 and the portion aft of the piston. Air passage 24 in cylinder wall 10 connects cylinder 9 to the rear portion of annular cylinder 11 and communicates with passage 25 which extends to the rear end of cylinder wall 10 where it connects with leg 26 of tube 27, which is in turn connected to a suitable source of pressurized air supply 41.

Piston 16 contains an air passage 28 extending from the forward end to the rear end thereof and which provides for free passage of air through the piston from the rear to the forward end of the cylinder thus equalizing the pressure on both sides of the piston 16. A series of annular grooves 29 around the circumference of piston 16 at spaced intervals communicate with passage 28 through lateral openings 30. A port 31 in the cylinder wall 10 communicates with passage 32 which extends rearwardly through cylinder wall 10 and connects with leg 33 of tube 34 which extends to the forward end of the drilling machine 1 and terminates in a nozzle 35 directed at the twist drill 3. Tube 34 and tube 27 are connected together intermediately of leg 33 and leg 26 by needle valve 36.

The portion of annular cylinder 11 forward of piston 22 acts as a lubricant reservoir and communicates with tube 37 through passage 38 in cylinder head 15. Tube 37 interconnects with tube 34 at point 39, a metering valve 40 being interposed in tube 37 between passage 38 and point 39.

In operation, when pressurized air is admitted from source 41 to actuate drilling machine 1, air simultaneously flows through tube 27 and is admitted through passage 24 into cylinders 9 and 11, pressurizing both cylinders and exerting a force on piston 22 which pressurizes the lubricant contained in the forward portion of cylinder 9. Valve 36 restricts the flow of air into tube 34 from tube 27 so that the pressure in tube 34 is considerably lower than that in tube 27. The low pressure air in tube 34 is carried by the tube to the nozzle 35 which directs it at drill 3. Piston 22, moving forward under the action of the pressurized air in the rear portion of cylinder 11, causes the lubricant to flow out through passage 38 into tube 37 and thence into tube 34 where the lubricant is entrained by the air moving through tube 34 and carried to the drill 3. Valve 40 serves to regulate the amount of lubricant introduced into the airstream so that a controlled amount of lubricant entrained in air is continuously delivered to the drill during the cutting operation. Simultaneously, as the drilling operation progresses and the drilling machine 1 advances drill 3 into the work 4, stud 6, which advances with the drill, carries with it the piston 16, moving the piston forward through the cylinder 9 and bringing each of the annular grooves 29 successively into alignment with port 31 in cylinder wall 10. As each of the grooves moves into alignment with the port 31, high pressure air from within cylinder 9 enters passage 28 in piston 16, passes outwardly through lateral openings 30 into annular grooves 29, and then into port 31 from where it is introduced into tube 34 through passage 32. Thus as piston 16 moves forward through the cylinder 11 and each of the annular grooves 29 moves past port 31, a succession of short blasts of high pressure air enters tube 34 and is directed at the drill 3 to blow away the chips produced by the drilling operation.

Since the flow of low pressure air through tube 27 is continuous throughout the drilling operation, an uninterrupted supply of lubricant is delivered to the drill from the nozzle 35 to provide adequate lubrication and insure proper cutting action of the drill. At the same time, the short sharp blasts of high velocity air, since they are emitted from the same nozzle, will not interfere with the delivery of the lubricant to the drill, but will be effective to blow away the chips produced by the cutting action. The intermittent action of the blasts is particularly effective to dislodge the oily chips which tend to cling to the drill and the work but because of the short duration of the blasts they will not prevent the lubricant being delivered by the air stream from adhering to the drill to provide adequate lubrication.

In addition, since automatic drilling machines of the type herein described are frequently used in gang drilling operations where large numbers of the drilling machines are operated from the same source of pressurized air supply, the short duration of the high pressure air blasts provides an advantage in reducing the required capacity of the air supply source, since chip removal by the method described uses only a fraction of the high pressure air required to direct a steady blast at the drill during the drilling operation.

Thus the combined lubricating and chip removing device herein described will automatically provide a constant supply of lubricant to a drill by causing the lubricant to be entrained in a stream of air directed at the drill, while at the same time effecting chip removal without disturbing the lubricating action, by augmenting the airstream with a series of intermittent high velocity air blasts directed from the same nozzle. This combination of controlled lubrication and positive chip removal makes possible the accurate and rapid drilling of holes with a high quality finish on the walls thereof which is not obtainable by conventional automatic drilling methods, and the economical use of pressurized air resulting from the intermittent action of the high pressure air blast reduces by a substantial amount the required capacity of the pressurized air source.

Although the present invention has been shown and described as being utilized in conjunction with a particular type of machine tool,

it is obvious that it may be adapted to use with any machine tool having a cutting action requiring lubrication and where automatic chip removal would be desirable.

In addition, it is to be understood that the invention is not confined to the precise details of construction herein set forth, as it is apparent that many changes and modifications may be made without departing from the scope of the invention, and no limitation is intended by the phraseology of the foregoing description or illustrations in the accompanying drawings.

I claim as my invention:

1. A chip removing and lubricating device for a machine tool having a moving cutting element, comprising a source of pressurized air, nozzle means for directing a stream of said air at said cutting element, a control valve interposed between said source of pressurized air and said nozzle means for regulating the flow of air from said nozzle means, a source of lubricant supply, means for introducing a continuous supply of said lubricant into said air so that a mixture of lubricant and air is delivered to said cutting element, and means including valve means adapted to be operatively connected to said tool for actuation in accordance with the motion of said cutting element and operative in response to said actuation to allow said pressurized air to by-pass said control valve intermittently during motion of said cutting element so that the mixture of lubricant and air being delivered to said cutting element is augmented by a series of air blasts for blowing away the chips produced by said cutting element.

2. In combination with a machine tool having a rotating cutting element, a chip removing and lubricating device comprising a cylinder, a source of pressurized air, means forming an opening in the wall of said cylinder for introducing pressurized air into the interior thereof, a piston contained within said cylinder with freedom for axial movement therein, means operatively connected to said piston for imparting reciprocal motion thereto, means forming a passage in said piston for admitting said pressurized air into the interior of said piston, means forming a series of axially aligned openings along the wall of said piston, said openings communicating with said passage, a port in the wall of said cylinder located so as to be aligned successively with each of said openings as said piston is moved axially within said cylinder, thereby admitting said pressurized air into said port during each period of alignment, conduit means connected to said port for conducting said pressurized air to said rotating cutting element, a source of lubricant supply, and means responsive to said pressurized air for introducing said lubricant into said conduit means so that a mixture of air and lubricant is directed at said rotating cutting element.

3. A combination chip removing and lubricating device for a machine tool comprising means forming a cylinder, a piston slidably contained within said cylinder, means for moving said piston axially within said cylinder, a source of pressurized air, conduit means for transmitting pressurized air from said source to the interior of said cylinder, means forming a passage to admit said pressurized air into the interior of said piston, said piston having a series of openings axially spaced along the side thereof and communicating with said passage, means forming a port in the wall of said cylinder, tube means connected at one end to said port whereby as said piston moves axially along said cylinder bringing each of said openings successively into alignment with said port, air will be admitted into said tube means during the period of such alignment, a source of lubricant supply, and means responsive to said pressurized air for introducing said lubricant into said tube means so that a series of intermittent blasts of air containing entrained lubricant are emitted from said tube means as said piston moves axially along said cylinder.

4. A drilling device comprising means for rotating and axially advancing a drill, a cylinder, means for introducing pressurized air into said cylinder, a piston slidably contained within said cylinder and adapted to advance axially with said drill, a series of grooves formed in the wall of said piston and axially spaced therealong, means forming openings to admit said pressurized air from the interior of said cylinder to the interior of said piston and thence outwardly to each of said annular grooves, means forming a port in the wall of said cylinder, a nozzle directed at said drill, and conduit means connecting said port to said nozzle whereby as each of said annular grooves moves successively into alignment with said port a blast of air enters said port and is conducted to said nozzle.

5. A chip removing and lubricating device for a machine tool having a cutting element, comprising a source of pressurized air, conduit means for delivering said air to said cutting element, a source of lubricant supply, interconnecting means for introducing said lubricant into said conduit means, and valve means interposed in said conduit means and adapted for operative connection to said tool for actuation thereby and arranged upon such actuation to cause intermittent flow of said pressurized air through said conduit means whereby a series of blasts of lubricant entrained in air is directed at said cutting element for simultaneously lubricating said element and removing chips produced by the cutting action of said element.

6. A chip removing and lubricating device for a machine tool having a cutting element, comprising a source of pressurized air, conduit means for delivering said air to said cutting element, a control valve interposed in said conduit means for restricting the flow of air therethrough, a source of lubricant supply, interconnecting means for introducing said lubricant into said conduit means whereby a mixture of lubricant and air is delivered to said cutting element, and valve means forming a by-pass around said control valve and adapted for operative connection to said tool for actuation thereby and arranged upon such actuation to cause intermittent flow of said pressurized air through said by-pass so that the mixture of lubricant and air delivered to said cutting element is augmented by a series of air blasts for blowing away the chips produced by said cutting elment.

7. A chip removing and lubricating device for a machine tool having a cutting element, comprising a source of pressurized air, conduit means for conducting said air from said source and directing it to said cutting element, a control valve interposed in said conduit means for restricting the flow of air therethrough, a source of lubricant supply, conduit means connecting said source of lubricant supply to said first mentioned conduit means whereby said lubricant is introduced into the air flowing through said

first mentioned conduit means, a valve adapted to regulate the flow of said lubricant into said first mentioned conduit means, and valve means adapted to be operatively connected to said tool for actuation thereby in accordance with the motion of said cutting element and arranged in response to such actuation to intermittently provide a by-pass around said control valve whereby the mixture of lubricant and air delivered to said cutting element is augmented by a series of air blasts for blowing away the chips produced by said cutting element.

8. In combination with a machine tool having a cutting element, a chip removing and lubricating device comprising a source of pressurized air, conduit means for conducting said air to said cutting element, a control valve interposed in said conduit means for restricting air flow therethrough, a reservoir containing a lubricant, conduit means connecting said reservoir to said first mentioned conduit means whereby said lubricant is introduced into the air flowing through said first mentioned conduit means, and valve means operatively connected to said tool for actuation thereby in response to the motion of said cutting element to intermittently provide a by-pass around said control valve whereby the mixture of lubricant and air delivered to said cutting element is augmented by a series of air blasts for blowing away the chips produced by said cutting element.

9. In combination with a machine tool having a cutting element, a chip removing and lubricating device comprising a source of pressurized air, conduit means for conducting said air to said cutting element, a control valve interposed in said conduit means for restricting the airflow therethrough, a reservoir containing a fluid lubricant, means responsive to said pressurized air for exerting pressure on said lubricant, conduit means connecting said reservoir to said first named conduit means whereby said lubricant is introduced into said air flowing through said first named conduit means, a second control valve interposed in said second conduit means for controlling the flow of said lubricant therethrough, and valve means operatively connected to said first named conduit means and to said tool for actuation in accordance with the motion of said cutting element and adapted in response to such actuation to intermittently provide a by-pass around said first control valve so that a mixture of lubricant and air augmented by a series of air blasts for removing chips produced by the cutting action of the tool is delivered thereto.

10. In combination with a machine tool having a cutting element adapted for simultaneous rotative and axial movement, a chip removing and lubricating device comprising a source of pressurized air, a tube connected to said source of pressurized air and directed at said drill for conducting said air to said drill, a valve interposed in said tube for restricting air flow therethrough, a source of lubricant supply comprising a cylinder, a floating piston contained within said cylinder, said cylinder being adapted to contain a quantity of lubricant in one end thereof, means connecting the other end of said cylinder to said source of pressurized air, lubricant conduit means connecting the other end of said cylinder to said tube so that the force exerted on said floating piston by said pressurized air in said other end of said cylinder will cause said lubricant to flow from said first end of said cylinder through said lubricant conduit means and into said tube, a valve interposed in said lubricant conduit means for regulating lubricant flow therethrough, an air pressurized air to said air cylinder whereby said cylinder, tube means connecting said source of pressurized air is conducted to said air cylinder, a piston slidably contained within said air cylinder and operatively connected to said cutting element so that axial movement thereof causes axial movement of said piston within said air cylinder, said piston having an axial passage formed therethrough so that air pressure is equalized in said cylinder on both sides of said piston, a series of grooves formed in the wall of said piston and spaced axially thereof, a series of lateral openings formed in said piston and connecting each of said annular grooves to said axial passage whereby said pressurized air from the interior of said cylinder is admitted to said annular grooves, a port formed in the wall of said air cylinder, and air conduit means connecting said port to the first of said tubes so that as said piston moves axially within said air cylinder and each of said annular grooves is momentarily aligned with said port, a blast of said pressurized air is admitted to said first of said tubes to augment the flow of lubricant and air therethrough.

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