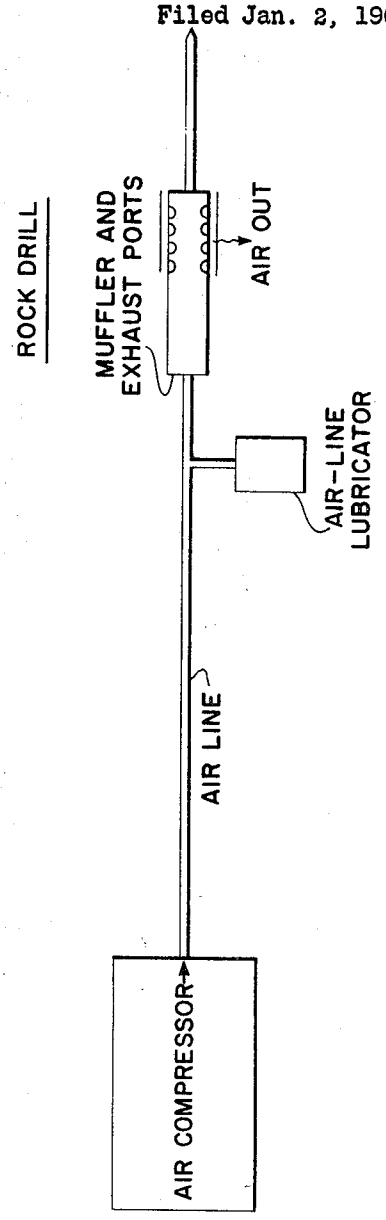
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METHOD OF OPERATING PNEUMATIC DEVICES

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METHOD OF OPERATING PNEUMATIC DEVICES

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ABSTRACT OF THE DISCLOSURE

The addition of minor amounts of an anti-icing agent such as isopropyl alcohol to a compressed air stream containing large amounts of water, such compressed air being used to operate a pneumatic device, will eliminate or severely reduce icing in the air exhaust ports of said pneumatic device. The anti-icing agent is usually added in conjunction with a lubricant to the compressed air stream, although such anti-icing agent may be added separately to the pneumatic device.

BACKGROUND OF THE INVENTION

Field of the invention

This invention relates generally to the elimination of icing problems which occur in the operation of pneumatic devices. More particularly, it is concerned with the addition of an anti-icing agent to a compressed air stream having a high water content in sufficient amounts so as to prevent the formation of ice on the air exhaust ports of said pneumatic device. More specifically, this invention relates to the addition of an anti-icing agent in conjunction with lubricating oil to a compressed air stream having a high water content, such compressed air being used to operate a pneumatic drill, in sufficient amounts so as to prevent icing in the air exhaust ports of such pneumatic drill.

DESCRIPTION OF THE PRIOR ART

The use of compressed air for the operation of machines such as jack hammers and rock drills is universally known. This operation usually comprises compressing air in a compressor and passing this compressed air to a machine such as a jack hammer, which through a complex series of valves and diaphragms causes the piston to move reciprocally. The compressed air, after being utilized in this process, passes through holes or ports in the drill to the atmosphere. Quite often the compressed air contains large amounts of water vapor which are passed through the pneumatic device as described above. Sometimes, when the drill is used in cold weather, the combination of low temperature and expansion of compressed air as it leaves the exhaust ports acts to freeze the water out of the air and in the exhaust ports of said device. This problem is enhanced in "muffler-type" drills which have small exhaust ports for noise reduction.

The newer drills have been designed so that the water vapor held in the air can be easily handled when it condenses out as the air is expanded and subsequently cooled. This has been achieved by redesigning the exhaust ports, the use of very thin conductive metal for the muffler, and coating the surfaces of the muffler with a non-wettable

material such as polytetrafluoroethylene. However, where large quantities of water are trapped in low spots in the air line and where "slugs" of water enter the drill with the compressed air, difficulties do occur. The exhaust ports become frosted over and the drill loses efficiency and in severe cases becomes inoperative.

Several attempts have been made to reduce the icing associated with "wet" air, none of which have been very successful. The lubricating oil has been formulated to be somewhat emulsifiable with the water to combat the effect of water on internal rusting and icing of the rock drill ports. Some drill equipment manufacturers have made modifications to the valve system to control the water and air pressure. Lowering the compressed air temperature in some cases has given relief. None of these efforts, however, have been successful in eliminating the problem of icing.

SUMMARY OF THE INVENTION

It has now been found that the icing problem associated with pneumatically driven machines having mufflers with air exhaust ports can be eliminated or markedly reduced by introducing into the water containing compressed air stream a lubricating composition containing, along with the lubricating oil, a minor amount of an anti-icing agent sufficient to prevent the formation of ice in the air exhaust ports.

The introduction of an anti-icing agent is necessary only in those cases where the air to be compressed has a high water content. When compressed to normal operative pressures, i.e. about 115 p.s.i.a., some of this water condenses into the air line and becomes mechanically entrained in the apparatus. The problem, as indicated above, becomes acute when the "wet" compressed air expands on exit from the muffler, keeping the muffler apparatus at a temperature below the freezing point of water (e.g. temperatures of —10° F. are not uncommon).

Generally, the anti-icing agent is mixed with the lubricating oil and this combination injected directly into the compressed air stream. This is the preferred method; however, it can be seen that the anti-icing agent may be added separately at another point in the compressed air stream or in the chambers of the pneumatic machine itself wherein the compressed air is utilized or in the exhaust lines prior to the muffler exhaust ports.

The types of lubricating oil as used in this invention are those types which are generally used in pneumatic devices. The oils are mineral or synthetic oils, preferably mineral oils. The mineral oils may be naphthenic, paraffinic or mixed based oils. Such oils should have a viscosity within the range of about 35 to 200 SUS at 210° F. and flash points of about 350° to 600° F. Lubricating oils having a viscosity index of 100 or higher may be employed.

The amount of anti-icing agent which is added to the compressed air will depend on the temperature, pressure and water content of the compressed air. Generally, only that amount is used which would be sufficient to prevent icing on the exhaust ports of the pneumatic device. A range of 0.0001 to 0.01 pound of anti-icing agent, preferably 0.001 to 0.003 pound per pound of water in the compressed air stream, is sufficient to prevent the formation of ice on the exhaust ports of the mufflers.

If the anti-icing agent is added along with the lubricating oil to the compressed air stream as is preferred, the

amount of anti-icing agent usually amounts to 0.05 to 5.0 pounds, preferably 0.50 pound per 100 pounds of lubricant injected into the compressed air stream, depending upon severity of operations.

A surprising feature of the method of operating a pneumatic device is the truly small amount of anti-icing agent which is necessary to prevent the formation of ice. It would be expected that the anti-icing agent, if employed in sufficient quantities would depress the freezing point of water and in that manner eliminate the icing problem. It has been observed, however, that the amount of anti-icing agent, as for example isopropyl alcohol, which does in fact act to eliminate icing is so small in relation to the amount of water in the system that the depression of the freezing point of water does not fully account for the anti-icing effect.

The pneumatic devices in which this method can be applied are those devices which have small exhaust ports through which the compressed air exits after use. This procedure also applies to those machines which are usually operated out of doors at less than room temperature. This procedure is especially applicable to jack hammers or rock drills. Other pneumatic devices in which this procedure may be employed include: air compressors, air wrenches and diamond drills.

The anti-icing agents as used in this invention are those organic materials which are commonly used to lower the freezing point of water. These materials may include C_1 to C_6 normal and branched chain alcohols, ketones such as acetones, and glycols such as ethylene glycols. The only qualification on the anti-icing agent is that it will not corrode or in any way interfere with the operation of the pneumatic device. Because the anti-icing agent is present in such small quantities, no adverse chemical effect on the moving parts of the machine would be expected.

Because it is preferred that the anti-icing agent be used in conjunction with the lubricating oil, it is preferable that the anti-icing agent be oil soluble. Isopropyl alcohol is preferred, as the quantity in which it is employed produces no solubility problems. Of course, other oil insoluble anti-icing agents may be employed in conjunction with the lubricating oil but there would be an accompanying need for a suitable emulsifier, e.g. sodium, petroleum sulfonates, which would insure a homogenous mixture of anti-icing agent and lubricating oil.

BRIEF DESCRIPTION OF THE DRAWING

The attached figure is a schematic diagram of the method of operation of a rock drill according to the procedures described herein.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to the figure, air containing water vapor is compressed in the air compressor. A small amount of a lubricating composition containing the anti-icing agent is injected into the compressed air stream at a point just before the air enters the rock drill. The compressed air containing entrained water and lubricant then passes into the rock drill causing the simultaneous lubrication and operation of the drill. The compressed air and unused lubricant then pass to a muffler having small exhaust ports to facilitate noise reduction. The anti-icing agent present in the lubricant prevents any condensed water from freezing in the exhaust ports and the air passes unimpeded into the atmosphere.

EXAMPLE 1

A "Muffler Type" rock drill made by the Joy Manufacturing Company and having a 3⅛ inch bore was operated at 115 p.s.i.g. and a temperature of 60° F. The drill consumed 175 ft.^{3} of air per minute of operation at this temperature and pressure. The drill required one pint of oil per hour when operating continuously. The compressed air contained 0.08 pound of water vapor per 1000 ft.^{3} plus about 0.2 pound of entrained water in the form of a fine mist or occasional slugs.

Under these conditions of operation, ice forms in the exhaust ports and on the valves of the muffler due to the drop in temperature caused by the expansion of the compressed air. The temperature of the air at the exhaust ports is well below the freezing point of water, occasionally reaching 0° F. The drill operated with great difficulty due to the plugging of the exhaust ports.

One ounce of isopropyl alcohol was added to one gallon of the lubricating oil forming a composition of 0.63 vol. percent alcohol and 99.37 vol. percent lubricating oil. The amount of isopropyl alcohol employed was 0.0021 pound per pound of water from the compressed air stream. When the composition containing the isopropyl alcohol was used, the degree of icing in the exhaust ports was appreciably reduced and the drill operated without difficulty.

In Example 1, the amount of alcohol employed in relation to the amount of water is very small and the anti-icing effect cannot be solely attributed to lowering of freezing point. As shown in the table, 10 vol. percent of isopropyl alcohol in an alcohol-water mixture only lowers the freezing point from 32 to 28° F. Much less than 10 vol. percent alcohol was employed in the example.

It could well be that droplets of isopropyl alcohol could coat the individual ice crystals, melting them and then the force of the exhaust air would mechanically dislodge the remaining ice formation.

TABLE I

Freezing points of alcohol-water mixtures

Concentration of isopropyl alcohol in water, vol. percent:	Freezing point, ° F.
0	+32
10	+28
20	+23
30	+17
40	+7
50	−8
60	−26

What is claimed is:

1. In a method of operating a pneumatically driven machine having air exhaust ports wherein a compressed air stream is employed as the driving force, said compressed air having a sufficiently high water content so as to cause ice formation on the exhaust ports of said machine, the improvement which comprises adding to the compressed air stream a deicing agent in sufficient amounts to prevent the water from forming ice in the air exhaust ports of said pneumatically driven machine.

2. The method of claim **1** wherein the amount of anti-icing agent added is 0.0001 to 0.01 pound per pound of water from the compressed air stream.

3. A method as in claim **2** wherein the amount of anti-icing agent added is 0.001 to 0.003 pound per pound of water from the compressed air stream.

4. A method as in claim **3** wherein the deicing agent is added to the compressed air stream in combination with the lubricating oil.

5. A method as in claim **4** wherein the deicing agent is isopropyl alcohol.

6. A method as in claim **5** wherein the pneumatically driven machine is a rock drill.

7. In a method of operating a pneumatically driven machine having air exhaust ports wherein compressed air is employed as a driving force, said pneumatically driven machine being equipped with a muffler having air exhaust ports, and wherein lubricating oil is employed for purposes of lubricating the moving parts of said machine,

the improvement which comprises adding to the compressed air stream a lubricating composition in sufficient amounts to lubricate said moving parts, said lubricating composition comprising a major amount of lubricating oil and a minor amount sufficient to prevent condensed water vapor from forming ice in the air exhaust ports of said pneumatically driven machine of a deicing agent.

8. A method as in claim **7** wherein the amount of deicing agent added to the compressed air stream is 0.05 to 5.0 pounds per 100 pounds of lubricating oil employed.

9. A method as in claim **8** wherein the lubricating oil is mineral lubricating oil.

10. A method as in claim **9** wherein the deicing agent is isopropyl alcohol.

11. A method as in claim **10** wherein the pneumatically driven machine is a rock drill.

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