Sept. 25, 1962 W. A. MORRISON ET AL 3,055,647

COMPRESSED GAS SYSTEM

Filed June 3, 1958

2 Sheets-Sheet 1

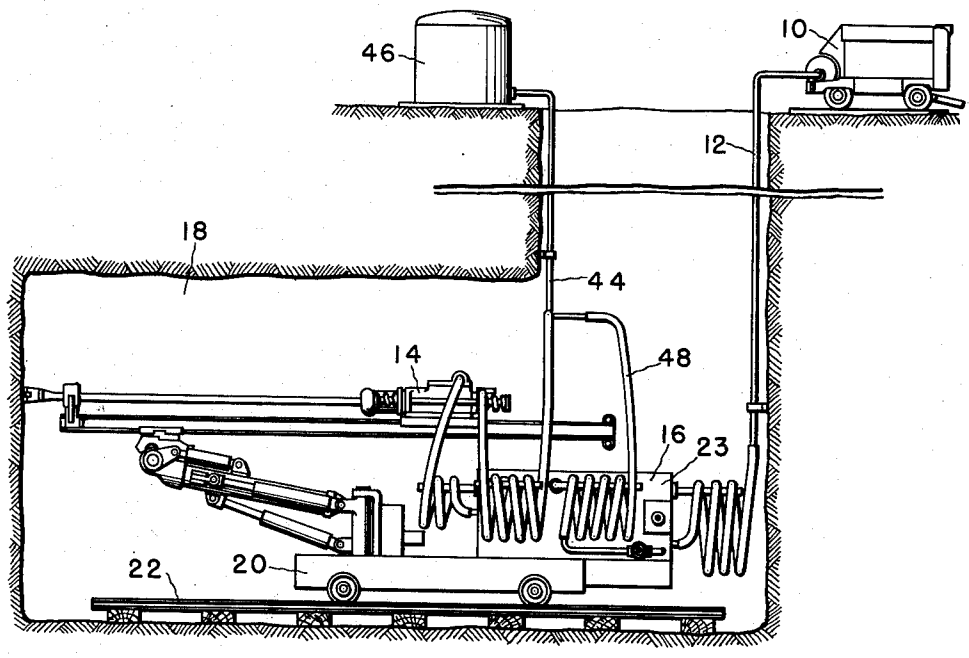


FIG. 1

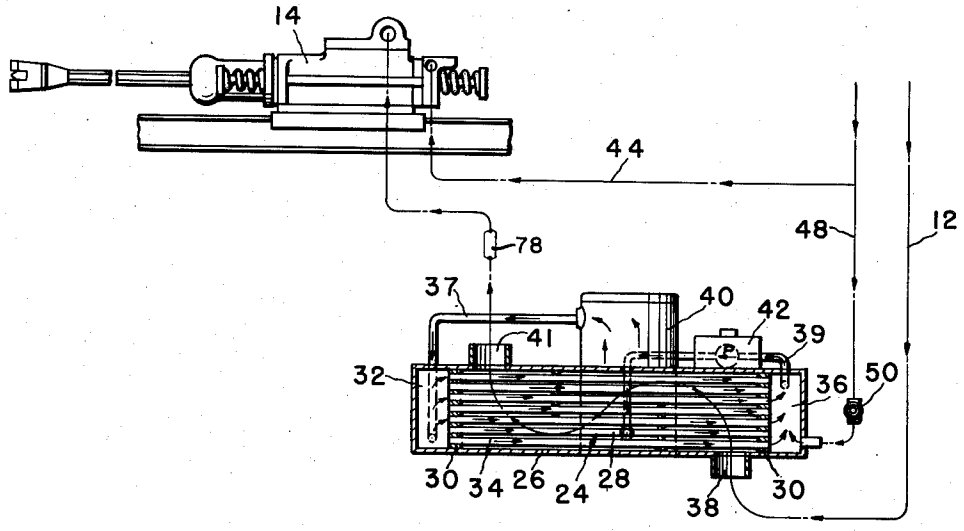


FIG. 2

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2 Sheets-Sheet 2

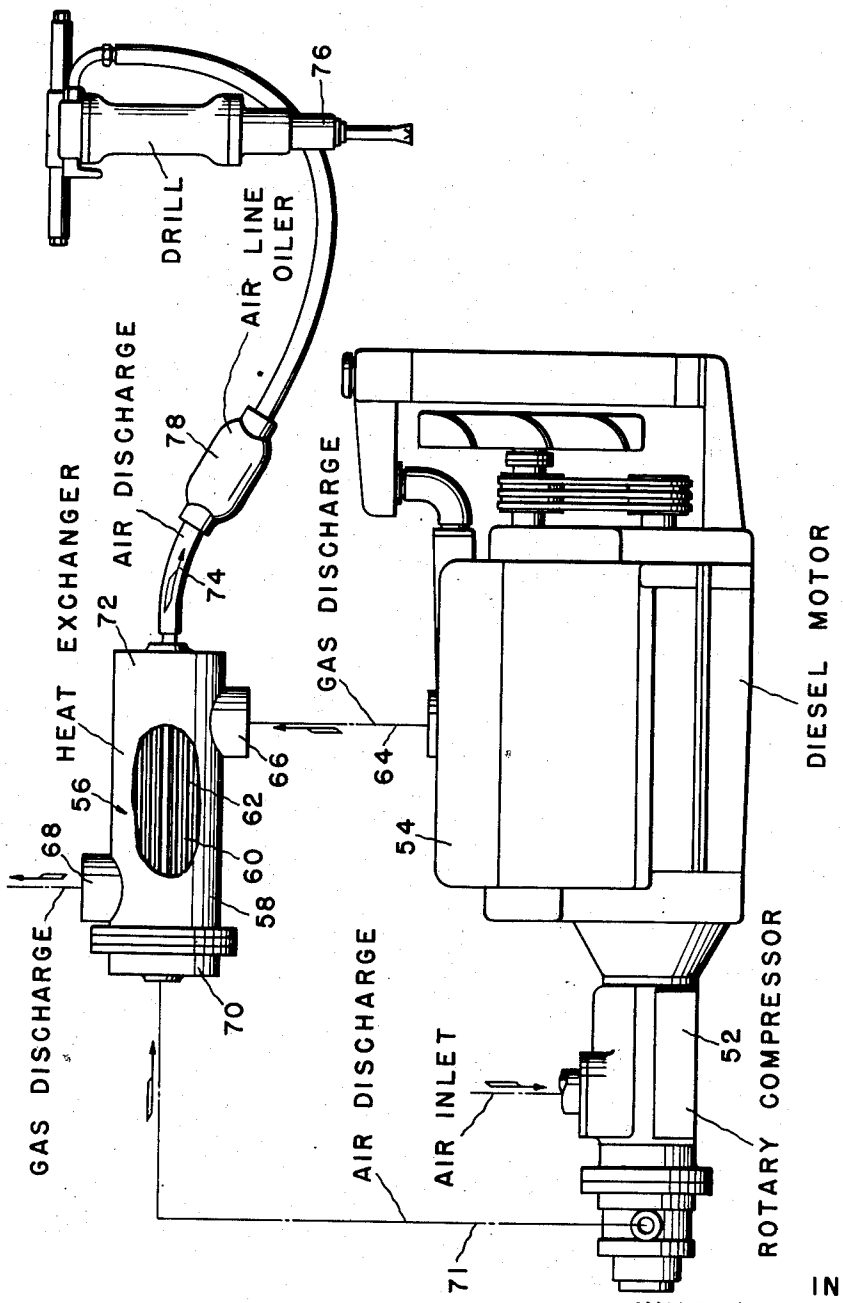


FIG. 3

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COMPRESSED GAS SYSTEM

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6 Claims. (Cl. 262—1)

This invention relates to a drilling apparatus, and more particularly to such apparatus in which a compressed gas system and a rock drill are components.

One object of this invention is to provide a means for limiting condensation caused by the exhaust of a rock drill.

Another object of this invention is to provide a power recovery means for the compressed gas system.

Another object of this invention is provide a power amplified compressed gas system in rock drill apparatus that stimulates lubrication of the drill and limits condensation of fogging at the drill exhaust.

This invention contemplates power amplified drilling apparatus having means for limiting condensation of exhausted compressed gas, comprising a gas operated rock drill having an exhaust for the operating gas, a compressor to provide compressed gas to operate the drill, and a heat exchanger having a flow path for the compressed gas connecting the compressor to the rock drill and having another flow path for circulating a heating medium to heat the compressed gas to amplify its power and to provide a residual temperature at the drill exhaust to limit condensation.

Further objects of this invention will become obvious from the following specification and drawings, in which

FIGURE 1 is a side view showing the components and how they are interconnected of one form of the invention,

FIG. 2 is a side view of the rock drill and heating system shown in FIG. 1, showing said heating system with its cover removed and partly in section, said view also diagrammatically shows the flow paths of the heating and heated mediums, and

FIG. 3 is a side view showing the components and how they are interconnected of another form of the invention.

Referring to the drawings, FIG. 1 for clarity shows the components located in a tunnel **18** enlarged with respect to the components located at the mouth of said tunnel **18**. FIGS. 1 and 2 show the combination of a compressor **10** for compressing gas, in this instance air, supplied through a conduit **12** to operate a pneumatic rock drill **14**, and an air heater **16** connected in said conduit **12** to heat such air. In the particular form of the invention shown, the compressed air system is adapted to a confined working area and more particularly to the tunnel **18**. The rock drill **14** and heater **16** are suitably mounted on a carriage **20** movable on rails **22** in the tunnel working area. The compressor **10** is of a conventional portable type commonly used in rock drilling operations and is located at the mouth of the tunnel **18**.

In the working area, the drill exhaust commonly causes fog or condensation. The compressed air, because of the work done by such air in operating the drill **14**, cools to sub-freezing temperatures and, when exhausted into the atmosphere of the working area, cools said atmosphere to cause fog. To limit fogging, the heater **16** is connected in the system to heat drill air before it is exhausted to the working area atmosphere. The air is heated to a temperature so that the residual temperature of the exhausted air is approximately equal in temperature to that of such atmosphere.

In addition to limiting fogging, by having the heater **16** as a component of the compressed air system adapted to heat such air before its use, the volume of compressed air available to the rock drill **14** is increased and the ability of such air to do work is also increased or amplified. Thus, the combination with the heater **16** in the conduit **12** serves not only as a power recovery system but a defogging device.

The heater **16**, shown in FIGS. 1 and 2, includes a cover **23** which houses the components of the heating system. The heating system is shown in FIG. 2 with the cover **23** removed. The system includes a heat exchanger **24** of a well known type adapted to keep the heating and heated mediums separated while passing through said exchanger **24** by providing a flow path for each medium. Accordingly, the exchanger **24** comprises a hollow casing **26** which houses a tube nest **28** therein by having partitions **30** slidably mounted in said casing **26** at both ends of said nest **28**. The partitions **30** serve to divide the casing interior into three fluid tight compartments **32**, **34** and **36**, and permit the tubes of the nest **28** to be open at their ends to the compartments **32** and **36**.

In this form of the invention, the heating medium is water which is conveyed to and from the outer compartments **32** and **36** by the conduits **37** and **39** which are suitably connected to the end portions of said casing **26**. The heated medium is compressed air conveyed to and from the center compartment **34** by the conduit **12** which is connected to said compartment **34** by an inlet **38** and an outlet **41** extending through the casing periphery. The hot water flows from the compartment **32**, through the tubes of the nest **28**, to the compartment **36** to heat the compressed air passing over the tubes in the compartment **34**.

The heater **16** further includes an electrically operated water heater **40** which heats water conveyed thereto by the conduit **39**. The heated water then flows from the upper portion of the heater **40** to the exchanger **24** via conduit **37**. To maintain a sufficient circulating water pressure, a pump **42** is connected to conduit **39**.

As shown, the heater **16** has a closed water system, however, make up water is drawn from the drill water supply. To achieve this end, a hose **44** conveys water from a supply **46** to the drill **14**, and a hose **48** connected to supply hose **44** conveys water to the conduit **39** via the exchanger compartment **36**. A valve **50** controls the flow of water through the hose **48** by an operator as it is needed by the heating system. To better understand the above described fluid flow paths of the compressed air and water, they are indicated in FIG. 2 by arrows.

The compressed gas system shown in FIG. 3 discloses another form of the invention. This combination of elements includes a rotary compressor **52** driven by an internal combustion engine **54**, and a heat exchanger **56** for heating compressed air.

The heat exchanger **56** is of a well known type much like the exchanger **24**, hereinbefore described, and includes a hollow casing **58** and a tube nest **60** suitably connected in said casing **58**. In this form of the invention the heating medium is the hot discharge gases of the engine **54** and said gases flow through the center compartment **62** (part of which is shown) to heat the compressed air passing through the tube nest **60**.

Accordingly, the exchanger center compartment **62** is connected to the engine exhaust conduit **64**, adjacent the engine **54**, by means of an inlet **66** extending through the casing periphery. This inlet **66** and an outlet **68** extending through the casing periphery for exhausting the spent engine gases from the exchanger **56** are located on opposite sides and ends of the casing portion that defines the peripheral boundaries of said compartment **62**. The heated medium, compressed air, is conveyed from the compressor **52** to the exchanger end **70** bounding one end of the compartment **62** by any suitable means, such as a hose (not shown), but indicated by line **71**, and is conveyed from the exchanger end **72** by a suitably connected

hose 74. The air is heated by the engine gases by flowing through the tube nest 60, said air flow being in an opposite direction to the flow of the exhaust gases. The hose 74 conveys the hot compressed air to a rock drill 76 to operate it.

In addition to being a component to a compressed gas system which serves as a defogging device and a power recovery system, the exchanger 56 serves as a muffler for the hot exhaust gases of the engine 54. This muffling effect is accomplished by slowing down the velocity of the engine exhaust gases by causing the heated gases to expand in the exchanger 56. The expansion of gases is due to the enlarged size of the exchanger 56 relative to the engine exhaust conduit 64 and dispersing of such gases by the tube nest 60 mounted in said exchanger 56.

The exchanger 56, in combination with an air line type oiler 78 used to lubricate the drill 76, serves as a stimulating means for increasing the effectiveness of the air line oiler 78. This oiler 78, connected in the hose 74, is of a conventional design and supplies oil to air supplied to the drill 76. By having the exchanger 56 heat the compressed air prior to its passage through the oiler 78, said air is capable of holding more oil and therefore said oiler 78 more effectively lubricates the drill 76.

While we have shown and described specific forms of our invention, it is to be understood that various changes and modifications may be made without departing from the spirit of the invention as set forth in the appended claims.

We claim:

1. The combination of a movable carriage located in a confined working area, a gas operated rock drill mounted on said carriage, a fluid conduit adapted to supply fluid to the drill, a compressor distant from said drill for compressing gas to be used to operate the drill, a gas conduit adapted to supply the compressed gas to the drill, a heat exchanger mounted on said carriage and connected in said gas conduit, a heating unit for heating fluid, conduit means connected to said fluid conduit and adapted to convey drill fluid to said heating unit, valve means in said conduit means for controlling the flow therethrough, a conduit connected to said heating unit and said heat exchanger for conveying heated fluid to the latter for heating the compressed gas passing therethrough, and a conduit connected to said heat exchanger and said heating unit for conveying cooled fluid to the latter, said exchanger being of the type in which the heating fluid and compressed gas are kept separate while passing therethrough.

2. The combination according to claim 1 and an oiler connected in the gas conduit between the heat exchanger and the drill to supply lubricant to the heated compressed gas for lubricating the drill.

3. Power amplified drilling apparatus having stimulated lubrication and means for limiting condensation of exhausted compressed gas, comprising a gas operated rock drill having an exhaust for the operating gas, a compressor to provide compressed gas for operating the drill, a heat exchanger in the hole being drilled having a flow path for the compressed gas connected to the compressor and having another flow path for circulating a heating medium for heating the compressed gas to amplify its power and to provide a residual temperature at the drill exhaust to limit condensation, and a gas line oiler connecting the compressed gas flow path to the rock drill and providing lubricant for the rock drill that is stimulated by the temperature of the heated compressed gas flowing therethrough.

4. Drilling apparatus according to claim 3 and having an engine connected to and driving the compressor, the engine having an exhaust for hot exhaust gas connected to the heating medium flow path of the heat exchanger to supply the hot exhaust gas to the heat exchanger for the heating medium.

5. Drilling apparatus according to claim 3 and having means in the hole being drilled for providing a liquid heating medium, comprising a liquid heater having an input adapted to receive a flow of liquid to be heated, valve means to control the flow of liquid to the heater, conduit means connecting the heater to the heating medium flow path of the heat exchanger for supplying heated liquid to such flow path and returning cooled liquid to the heater, and pump means connected to the heater for causing the circulating flow of liquid.

6. Drilling apparatus according to claim 3 and a conduit connected to the rock drill to provide a flow of fluid thereto, the input of the heater being connected to the conduit to receive the fluid to be heated.

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