

[54] AMMONIA DRIVEN UNDERWATER
MOTOR

[75] Inventor: Charles R. Rein, Panama City, Fla.

[73] Assignee: The United States of America as
represented by the Secretary of the
Navy, Washington, D.C.

[22] Filed: Oct. 18, 1973

[21] Appl. No.: 408,028

[52] U.S. Cl. 60/649, 417/391, 60/651

[51] Int. Cl. F01k 25/06

[58] Field of Search 60/36, 649; 173/DIG. 1;
175/93; 417/391

[56] References Cited

UNITED STATES PATENTS

121,909 12/1871 Tellier..... 60/36
3,802,519 4/1974 Newton..... 173/DIG. 1

FOREIGN PATENTS OR APPLICATIONS

735,818 5/1943 Germany 175/93

Primary Examiner—Martin P. Schwadron

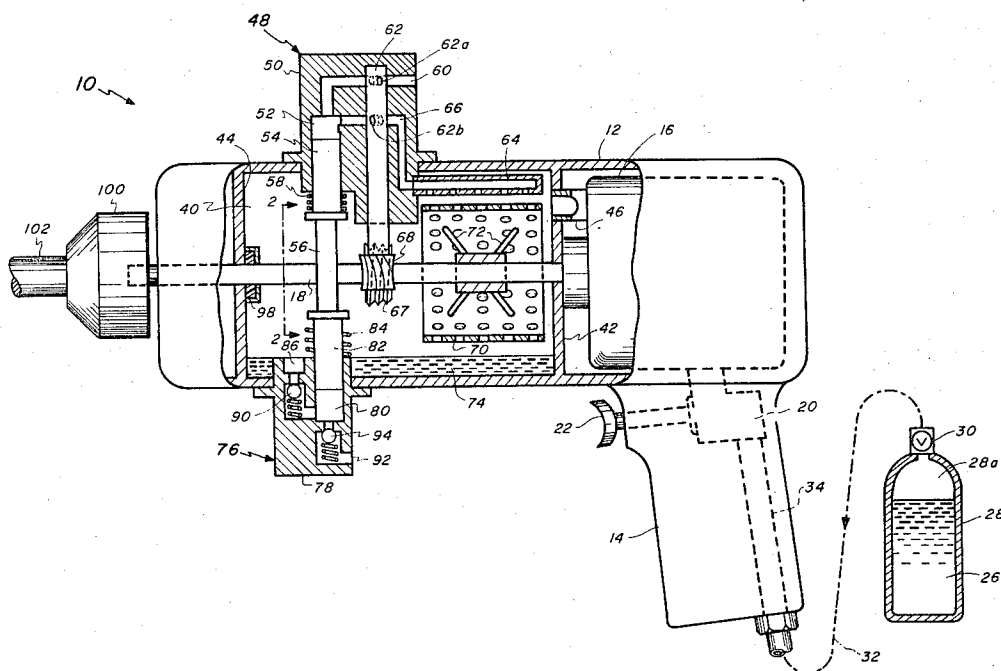
Assistant Examiner—H. Burks, Sr.

Attorney, Agent, or Firm—Richard S. Sciascia; Don D.
Doty; Harvey A. David

[57] ABSTRACT

An ammonia powered motor device for use in deep water is described as comprising a housing defining a chamber into which an ammonia gas pressure operated motor exhausts. A metering pump admits quantities of water from the surrounding medium into the chamber to absorb ammonia and lower exhaust pressure while ammonia laden water is pumped from the chamber.

11 Claims, 2 Drawing Figures



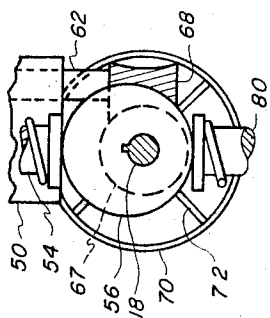


FIG. 2

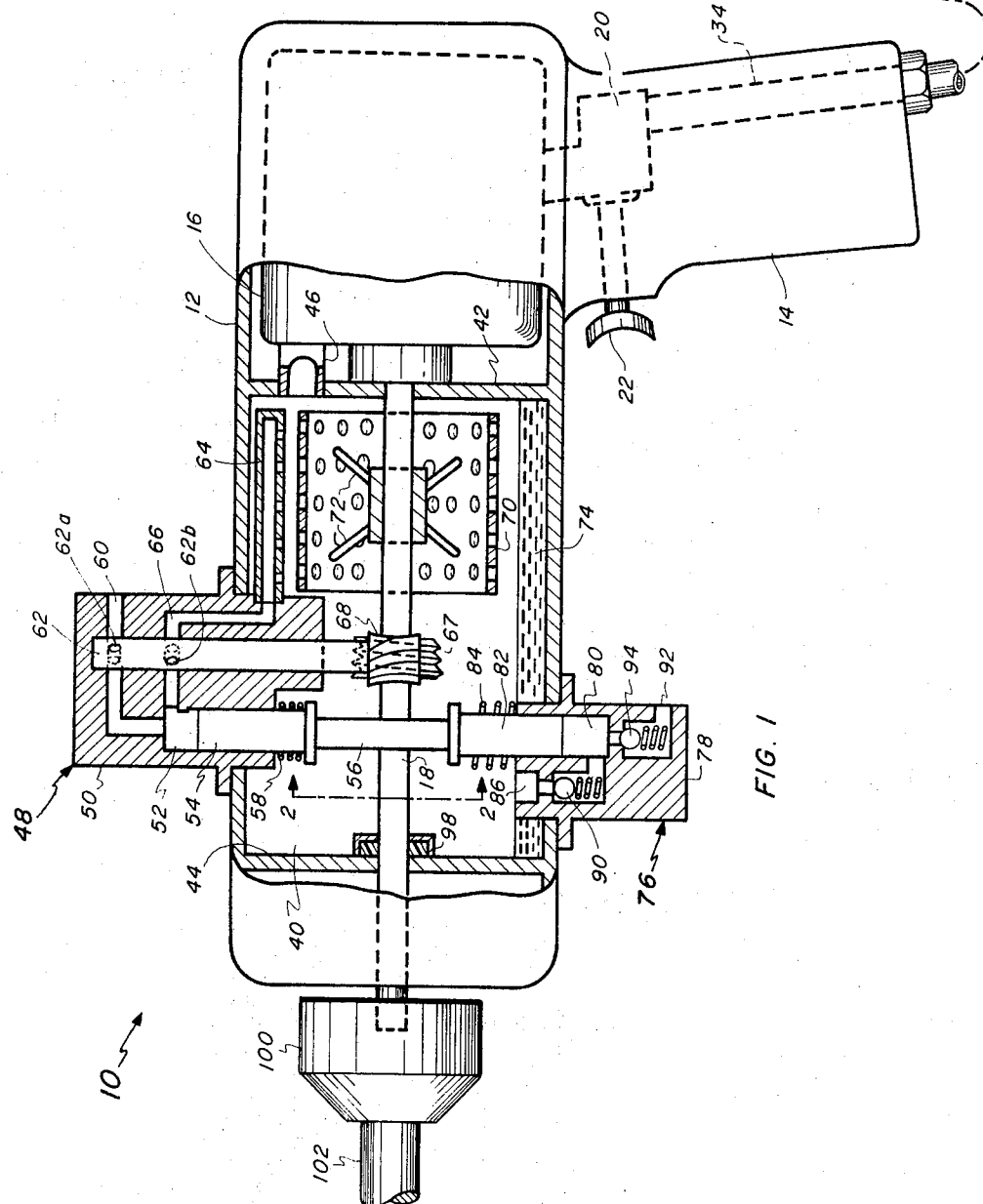


FIG. 1

AMMONIA DRIVEN UNDERWATER MOTOR**STATEMENT OF GOVERNMENT INTEREST**

The invention described herein may be manufactured and used by or for the Government of the United States of America for Governmental purposes without the payment of any royalties thereon or therefor.

FIELD OF THE INVENTION

This invention relates to powered devices for use in underwater environments and more particularly to improvements in use of ammonia as a power source for motors of devices such as drills or other hand tools to be used by divers, underwater propulsion means, or the like. Electrically powered tools have serious disadvantages for underwater work including danger of electrical shock, electrolytic damage to metal equipment, divers' dental fixtures, and difficulty of maintenance. Reduction of voltage to reduce shock potential is accompanied by motors of greater size to accomplish a given amount of work.

Pneumatically powered tools have generally proven to be more satisfactory for underwater work from safety and maintenance points of view but suffer the disadvantage of requiring large volumes of air and inordinately high pressures at the pressurized air source in order to maintain a satisfactory pressure differential with respect to water pressure at depths of hundreds of feet. Moreover, air pressure operated tools are characterized in use by considerable quantities of bubbles originating at the tool exhaust ports, which bubbles obscure a user's view of the work site. Also, in cases of covert military operations, air bubbles would betray the presence of an intruder. It would be desirable to have powered, underwater tools or other devices that have the safety and reliability of air powered devices, but without the mentioned disadvantages thereof.

DISCUSSION OF THE PRIOR ART

Ammonia has been proposed as a power medium for torpedoes and other automotive vehicles because of the fact that liquified ammonia can be conveniently stored at safe pressures and temperatures in a container. Moreover, as an advantage in a marine power system, the vaporous ammonia or gas can be readily absorbed in reasonable quantities of water after work is extracted in an expansible chamber engine, thereby reducing or eliminating the presence of bubbles. U.S. Pat. No. 2,356,546, issued Aug. 22, 1944, to H. Tailleferre, is exemplary of such a system. The water into which the expanded ammonia gas is absorbed, in the power plant of that patent, is maintained at a predetermined level by a float valve that admits water from the surrounding medium, while a pump pumps ammonia laden and heated water through a liquid ammonia heating exchanger and then overboard. The use of a float valve to maintain the water level in the ammonia absorbing water reservoir is only satisfactory in a device such as a torpedo that has controls to maintain a predetermined attitude and would not be suitable for a hand tool that must be useable in a variety of positions.

SUMMARY OF THE INVENTION

The invention aims to overcome most or all of the disadvantages of prior art, underwater, powered devices, through the provision of an underwater powered device that utilizes ammonia gas derived from a liqui-

fied ammonia supply, and which is characterized by novel constructions, combinations and arrangements of parts that permit efficient operation and operation in various attitudes.

With the foregoing in mind, it is an important object of the invention to provide an improved underwater power tool that is safe in operation.

Another important object is the provision of a powered hand tool that can be utilized by divers at substantial water depths.

Another object is to provide an ammonia powered hand tool such as a drill or the like that comprises a closed chamber in which exhausted or spent ammonia gas from a motor is brought into contact with water to effect a reduction in exhaust pressure and hence more efficient operation of the use of energy from expansion of the ammonia.

Still another object is the provision of improved means for automatically maintaining a predetermined volume of water in the ammonia absorbing chamber, while introducing a supply of water from the surrounding water medium and expelling ammonia laden water from the chamber.

Yet another object is the inclusion of means, operated from the motor shaft, for increasing the surface area of water entering the chamber so as to effect rapid and complete absorption of the ammonia gas.

Other objects and many of the attendant advantages will be readily appreciated as the subject invention becomes better understood by references to the following detailed description, when considered in conjunction with the accompanying drawings.

DESCRIPTION OF THE DRAWINGS

FIG. 1 is a view partly in elevation and partly in longitudinal section illustrating a hand tool embodying the invention; and

FIG. 2 is a fragmentary sectional view taken substantially along line 2-2 of FIG. 1.

DESCRIPTION OF THE PREFERRED EMBODIMENT

In the exemplary form of the invention illustrated in the drawings and described hereinafter, there is provided an ammonia powered device 10 of the type ordinarily referred to as a drill and which is particularly well suited for underwater use by divers working at considerable depths. The device 10 comprises a generally cylindrical housing 12 from which a pistol-type grip 14 extends. Within one end portion of housing 12 is contained a motor 16, preferably one of the expansible chamber types well known for use with pressurized air as the source of power. Such motors are well known and need not be described in detail. Suffice it to say here that motor 16 comprises a rotary output shaft 18 that is caused to revolve when pressurized gas is admitted to an inlet port as by a control valve 20 that is conveniently disposed in grip 14 and can be actuated by a finger operated "trigger" or control button 22.

Ammonia gas under pressure for operating motor 16 is derived from a supply of liquid ammonia 26 held in a suitable flask or container 28. Ammonia 26 evaporates to provide a supply of gas in an ullage space 28a of container 28, from which it is lead through a valve 30, a flexible supply line or hose 32, and a conduit 34 in grip 14 to valve 20. The pressure/temperature relationships of ammonia, as well as its other physical prop-

erties, are well known for purposes of serving as a power source and so will not be dwelt upon. It should be noted, however, that provisions for heating the ammonia 26 in container 28 are desirable but form no part of this invention per se.

Housing 12 is further characterized by a chamber 40, situated between walls 42 and 44 in the housing, and through which walls motor shaft 18 extends. Ammonia gas exhausted by motor 16 is introduced into chamber 40 through wall 42 via a motor exhaust pipe 46 to be absorbed by water within that chamber.

A continuous, measured supply of water is introduced into chamber 40 from the surrounding water medium whenever the motor 16 is running. To this end, a water intake and metering pump 48 is provided comprising a body 50 extending through the housing 12 into chamber 40 and defining a cylinder 52 in which a piston or plunger 54 is adapted to reciprocate. Plunger 54 is caused to follow an operating cam 56 on shaft 18 by a spring 58. Cylinder 52 communicates with the surrounding medium through an inlet passage 60 controlled by a rotary valve 62, and with a water distributing tube or gallery 64 through a passage 66 controlled also by the rotary valve 62. Gallery 64 is provided with a plurality of inwardly directed water spray openings for a purpose that will be made apparent as this specification proceeds. Rotary valve 62, has transverse ports 62a, 62b that are adapted to align with passages 60 and 66, respectively, in timed relation to movements of plunger 54. This is accomplished by providing a worm gear 67 on shaft 18 in driving relation to a worm wheel 68 on rotary valve 62. The timed relation is such that passage 60 is open only during movements of plunger 54 in a direction that will permit water to flow through that passage into cylinder 52, whereas passage 66 is open only during movements of the plunger in a direction that will expel water from cylinder 52 through passage 66 into gallery 64 and out the spray openings thereof.

It will be appreciated that although the ambient pressure of the surrounding water medium may exceed the internal pressure of chamber 40 by hundreds of pounds per square inch, rotary valve 62 will function to seal cylinder 52 from that pressure during those times when plunger 54 is expelling water therefrom so that the motor 16 will not have to do useless work against external pressures. Operation of plunger 54 serves the dual purpose of expelling water from gallery 64 into chamber 40 and of providing a precise metering thereof.

Mounted on shaft 18, for rotation therewith, is a cylindrical drum 70, the diameter of which is such that ammonia entering chamber 40 from pipe 46 passes over the outer and inner surfaces of the drum. Drum 70, which is supported from a central hub by spokes 72, is conveniently perforated so that water spraying from gallery 64 will not only spread over the exterior of the drum but will also pass through the perforations and spread over the inner surfaces of the drum. This distribution of water provides a large, moving water surface area that materially increases the rate of absorption of ammonia in the chamber.

Water in which ammonia has been absorbed collects in the lower extremities of chamber 40 as shown at 74 and, to the extent that it exceeds a predetermined volume, is expelled from the chamber by a pump 76. Thus, pump 76 comprises a pump body 78, extending through the wall of housing 12 into chamber 40 and de-

fining a cylinder 80 in which a piston or plunger 82 is adapted to reciprocate. Plunger 82 is caused to follow cam 56 by a spring 84 so as to be reciprocated in cylinder 80.

Cylinder 80 communicates with the interior of chamber 40 via an intake well 86 having a passage controlled by a spring biased check valve 90, and with the medium surrounding device 10 via an outlet port 92 controlled by a spring biased check valve 94. When motor 16 is operating, and when the volume of ammonia laden water 74 is such that it flows into well 86, pump 76 serves to eject such water from chamber 40 at substantially the same rate that water from the surrounding medium is metered into the chamber by pump 48. The position of well 86 is such that substantially the same volume of water will be maintained in chamber 40 whether the device 10 is operated in its illustrated position, in a position wherein the shaft is vertical with the drill bit extending downwardly, or any position therebetween. It should also be noted at this point that the effective displacement of pump 76 should at least equal, or may slightly exceed, that of pump 48.

Shaft 18, which is conveniently surrounded by a seal 98 to prevent leakage therearound through wall 44, is coupled to a chuck 100 for holding a toolpiece 102, such as a drill bit for example. Of course, the coupling between shaft 18 and chuck 100 may include reduction gearing within housing 12, in accordance with common practice in rotary power tools.

Because chamber 40 is also sealed by metering pump 48 and by pump 76 absorption of ammonia by the water serves to lower the effective pressure within chamber 40, thereby increasing the useful pressure differential available to operate motor 16, an important feature when the device is to be used at substantial water depths.

Although the invention has been described with reference to a preferred embodiment in the form of a hand tool it will be recognized that the invention can be utilized as well to drive other mechanisms in deep water, such as winches and propellers, for example.

Obviously, other embodiments and modifications of the subject invention will readily come to the mind of one skilled in the art having the benefit of the teachings presented in the foregoing description and the drawings. It is, therefore, to be understood that this invention is not to be limited thereto and that said modifications and embodiments are intended to be included within the scope of the appended claims.

What is claimed is:

1. A motive device for operation within a surrounding water medium from a source of ammonia gas, said device comprising:

motor means, including a rotary output shaft and having gas inlet and exhaust ports, for producing rotation of said shaft;

a rigid housing defining a closed chamber, connected to said exhaust port, for receiving spent ammonia gas from said motor means;

water metering means, mounted on said housing and operatively associated with said motor means, for introducing predetermined amounts of water from said medium into said chamber for absorbing said spent ammonia gas; and

water expelling pump means, mounted on said housing and operatively associated with said motor means, for expelling ammonia laden water from

5

said chamber into said surrounding water medium.

2. A motive device as defined in claim 1, and wherein:

said shaft extends through said chamber; and
said operative associations of said water metering means and said water expelling means with said shaft comprise off center cam means on said shaft.

3. A motive device as defined in claim 2, and wherein:

said water metering means comprises spray means for increasing the surface area of said predetermined amounts of water as they are introduced into said chamber.

4. A motive device as defined in claim 3, and further comprising:

moving surface means, operatively connected to said shaft in the path of water from said spray means and having surfaces disposed in the path of said spent ammonia gas as it enters said chamber.

5. A motive device as defined in claim 4, and wherein:

said moving surface means comprises a perforated, cylindrical drum concentrically mounted on said shaft and disposed with one end adjacent said exhaust port.

6. A motive device as defined in claim 4, and wherein:

said water metering means comprises a body defining a cylinder and having inlet and outlet passages, a plunger reciprocable in said cylinder by said off center means, and valve means positively actuated from rotation of said shaft to alternatively open and close said inlet and outlet passages in predetermined timed relation to reciprocation of said plunger.

7. A motive device as defined in claim 6, and wherein:

said water expelling means comprises a positive displacement pump.

8. A motive device as defined in claim 7, and wherein:

said positive displacement pump is characterized by intake means within said chamber that renders said pump operative only to expel water therefrom in excess of a predetermined volume.

9. A motive device as defined in claim 8, and wherein:

said water expelling pump has a capacity at least

6

equal to the capacity of said metering means, whereby water in said chamber is prevented from accumulating substantially beyond said predetermined volume.

10. A motive device as defined in claim 9, and wherein:

said moving surface means comprises a perforated cylindrical drum concentrically mounted on said shaft for rotation therewith and disposed in alignment with flow of said ammonia into said chamber.

11. A power tool for use at substantial water depths from a source of ammonia gas under pressure, said tool comprising:

a rigid housing defining an ammonia receiving chamber;

an expansible chamber, rotary motor mounted at one end of said housing, said motor having a rotary shaft extending through said ammonia receiving chamber, an inlet port connected to said source, and having an exhaust port communicating with said ammonia receiving chamber;

a water metering pump mounted on said housing and comprising a body defining a first cylinder connected by an inlet passage to the exterior of said housing and by an outlet passage to said ammonia receiving chamber, said metering pump further comprising a first plunger reciprocable in said first cylinder in response to rotation of said shaft and a rotary valve member operative to alternatively open and close said inlet and outlet passages in timed relation to reciprocation of said plunger;

a water expelling pump mounted on said housing and comprising a body defining a second cylinder connected by an inlet passage to a predetermined location within the interior of said ammonia receiving chamber and by an outlet passage to the exterior of said housing, said water expelling pump further comprising a second plunger reciprocable in said second cylinder in response to rotation of said shaft and first and second check valves in said inlet and outlet passages, respectively;

a cam rotatable with said shaft for effecting reciprocation of said first and second plungers;

cooperating gears on said shaft and rotary valve member for effecting said timed relation; and

chuck means, coupled to said shaft, for holding a tool piece.

* * * * *

50

55

60

65