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Hall et al.

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[54] **PULSED JET RIOT CONTROL APPARATUS**

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[52] **U.S. Cl.** **239/102**, 239/322

[51] **Int. Cl.** **B05b 1/08**

[58] **Field of Search** 239/101, 102, 308, 321, 322, 239/331; 137/209; 169/9, 31, 33

[56] **References Cited**

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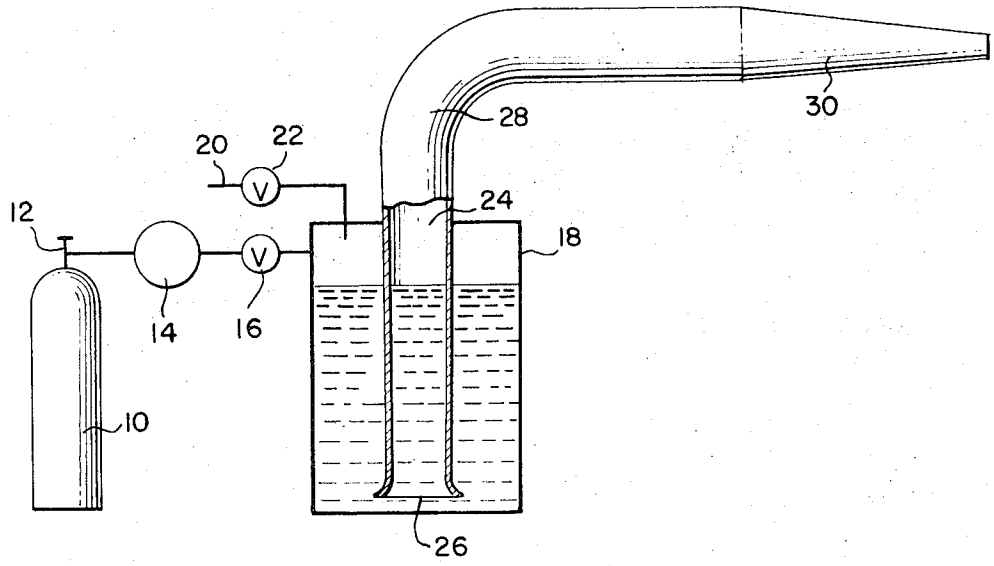
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[57] **ABSTRACT**

Apparatus for forming pulsed jets of liquid at relatively low pressures and capable of expelling the pulsed jets over moderate distances for use as a riot control device. A compressed gas is passed to a chamber having liquid therein so that upon actuation of a quick opening valve the liquid is forced from the chamber, through an acceleration tube and out a nozzle. The quick opening valve might be positioned between the pressurized gas source and the liquid chamber, or it might be in the acceleration tube. The gas can act directly on the liquid or it can act through a piston.

9 Claims, 4 Drawing Figures



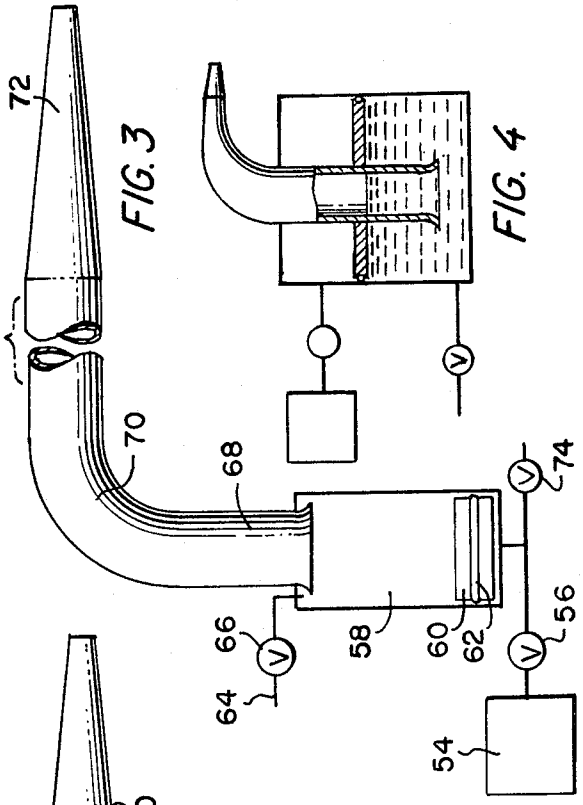


FIG. 3

FIG. 4

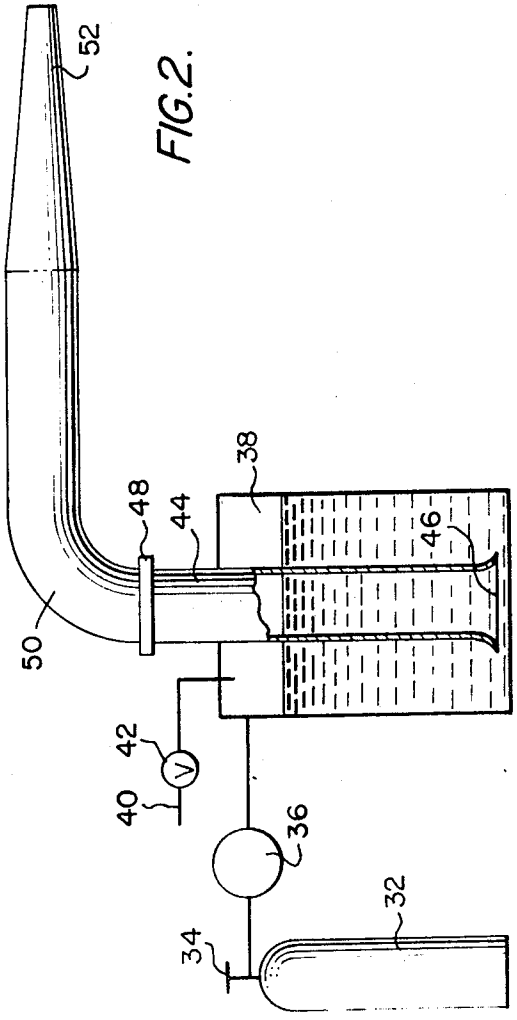


FIG. 2.

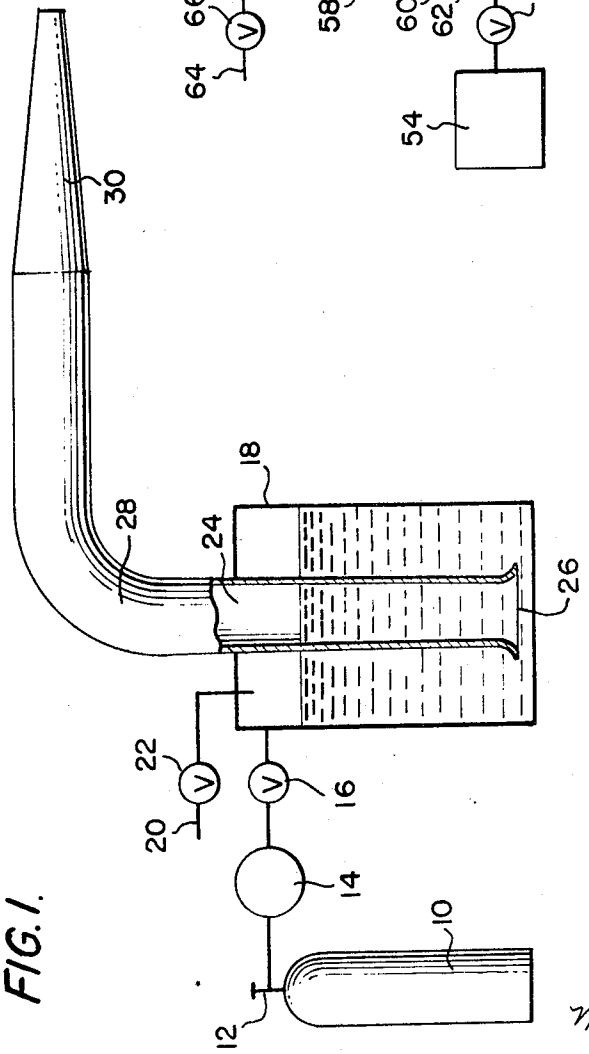


FIG. 1.

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PULSED JET RIOT CONTROL APPARATUS

The present invention pertains to apparatus for forming low pressure pulsed jets of liquid. More particularly, the present invention pertains to apparatus suitable for riot control and capable of transmitting pulsed jets of liquid at relatively low pressures over distances and suitable for such uses as riot control.

One of the more effective means of riot control is the spraying of water on the rioting crowd.

The use of water as a means for dispersing a crowd has many advantages. The water flow is easy to control. It can be turned off and on by a solenoid actuated valve. The area is largely uneffected once the water is stopped. The spraying of the water can be maintained in a desired direction without spraying into other areas. Water is nontoxid and so causes no lasting injury to the crowd. Water is generally readily available in large quantities and is inexpensive. Additives can be used with the water is desired.

If a continuous stream of water is used in riot control, the water spraying apparatus must be connected to a large water source. Fire hoses connected to hydrants have been utilized for this purpose; however, this restricts the area in which the water can be utilized to a relatively short radius in the vicinity of the hydrant. If the water is expelled as pulsed jets rather than in a steady stream, considerably less water is required, making possible the use of a mobile vehicle which carries a reservoir of water and which can be moved from area to area as required.

The present invention is an apparatus for generating pulsed jets of liquid at relatively low pressures, for example pressures in the order of about 100 to about 500 p.s.i., and capable of traveling moderate distances, for example distances in the range of from about 50 feet to about 150 feet. In accordance with the present invention, a compressed gas is passed to a chamber containing water. Upon actuation of a quick opening valve, the water is forced through an acceleration tube and out a nozzle. The quick opening valve might be positioned between the pressurized gas source and the water chamber or it might be positioned between the water chamber and the acceleration tube with the compressed gas continuously acting upon the water. The compressed gas can either act directly on the water or can act on the water through a piston.

These and other aspects and advantages of the present invention are more apparent in the following detailed description and claims, particularly when considered in conjunction with the accompanying drawings. In the drawings:

FIG. 1 is a schematic representation of a first embodiment of apparatus in accordance with the present invention;

FIG. 2 is a schematic representation of a second embodiment of apparatus in accordance with the present invention;

FIG. 3 is a schematic representation of a third embodiment of apparatus in accordance with the present invention; and

FIG. 4 is a schematic representative of a further embodiment of apparatus in accordance with the present invention.

In accordance with the embodiment of the present invention depicted in FIG. 1, gas from a pressurized

supply **10** passes through valve **12** to single-shot accumulator **14** which holds enough gas for one operation of the device. The outlet of accumulator **14** is coupled by quick opening valve **16** to the upper portion of tank **18**. Water from an inlet **20** is supplied through valve **22** to tank **18**. Acceleration tube **24** has its inlet tank **26** within tank **18** and near the bottom of the tank. Acceleration tube **24** preferably includes a flexible portion **28** making it possible to direct water jets in any direction. Acceleration tube **24** has its outlet connected to nozzle **30** from which the water jets are discharged. Preferably, acceleration tube **24** has a diameter in the order of ¾ of an inch up to 2 or 3 inches and nozzle **30** has an inlet diameter of the same order, a tapered outlet diameter which reduces the diameter in the order of about ¾ to 1 inch and a length in the order of about 15 to 30 inches.

Water from inlet **20** is passed through valve **22** to tank **18** filling the tank to a level just below the tank inlet from valve **16**. When it is desired to generate pulsed jets of water, quick opening valve **16** is actuated, releasing pressurized gas from accumulator **14** into tank **18**. The pressurized gas acts on the water in tank **18**, forcing the water through inlet **26** of acceleration tube **24**. The water passes through tube **24** and out nozzle **30**. The decreasing internal diameter of nozzle **30** increases the water velocity with the result that a pulsed jet of water having a diameter in the order of one to two inches is discharged at a pressure in the order of 100 to 500 p.s.i. and typically might travel a distance in the order of 50 to 150 feet. The embodiment of FIG. **1** is preferably mounted on a vehicle, not shown, such as a truck body, os that it is easily transportable.

The apparatus of FIG. **1** can readily be assembled, for example of steel and ready made tubing. Valves suitable for use as quick opening valve **16** have been developed in conjunction with rocket propulsion systems and are capable of millisecond operation.

FIG. **2** depicts apparatus in accordance with the present invention and having pressurized gas source **32** coupled by valve **34** to accumulator **36**, the outlet of which is connected to tank **38**. Water inlet **40** is coupled by valve **42** to tank **38**. Acceleration tube **44** has its inlet **46** adjacent the bottom of tank **38**. Quick opening valve **48** intersects acceleration tube **44** between inlet **46** and bent portion **50** which can be flexible. The acceleration tube continues from flexible portion **50** and has its outlet connected to nozzle **52**.

The operation of the embodiment of FIG. **2** is similar to that of FIG. **1**. Gas from source **32** continuously applies pressure through accumulator **36** on the water within tank **38**. When it is desired to discharge a pulsed jet, quick opening valve **48** is operated, permitting the water to pass through acceleration tube **44** to nozzle **52** from which it is discharged. Also, if desired, hydraulic pressure can be used to apply pressure on the water directly through a piston, or can be used to cock a piston which is then actuated by gas, or by other means, as depicted in FIG. **4**.

FIG. **3** depicts a further embodiment of apparatus in accordance with the present invention. Gas from a pressurized source **54**, which can include a single shot accumulator, is applied to quick opening valve **56**, the outlet of which is connected to the first end of tank **58**.

Piston **60** fits snugly but slidingly within tank **58** and, if desired, can include piston ring **62** to provide a substantially fluid-tight seal. Water from an inlet **64** is applied through valve **66** to the second end of tank **58** on the side of piston **60** opposite valve **56**. Acceleration tube **68**, including flexible portion **70**, extends from the second end of tank **58** and connects to nozzle **72**. when it is desired to generate a pulsed jet of water with the apparatus of FIG. **3**, water from inlet **64** is passed through valve **66** to fill tank **58**. Quick opening valve **56** is then actuated, and pressurized gas from source **54** moves piston **60**, expelling the water through acceleration tube **68** to nozzle **72** from which it is discharged. Valve **74** is then opened to release the gas from tank **60**, permitting piston **60** to return to the initial position under pressure of water from inlet **64** or gravity. If desired, valve **74** can return this discharged gas to source **54**.

It is thus seen that in accordance with the present invention a simple, economical and flexible apparatus is provided for generating pulsed jets of liquid at relatively low pressures. Although the invention has been described with reference to preferred embodiments, numerous rearrangements and modifications can be made and still the result would be within the scope of the invention.

What is claimed is:

1. Riot Control apparatus utilizing pulsed jets of liquid comprising:

an enclosed liquid reservoir having a first valved inlet adapted for connection to a source of liquid and having a second inlet;

a gas supply line coupled to said second inlet and adapted for connection to a pressurized gas source;

an acceleration tube having an outlet and having an inlet within said enclosed liquid reservoir;

a nozzle connected to said acceleration tube outlet; and

quick opening valve means coupled to said enclosed liquid reservoir and capable of actuation to expel liquid, under pressure of gas from said gas supply line, through said acceleration tube and out said nozzle as a pulsed liquid jet.

2. Apparatus as claimed in claim **1** in which said quick opening valve couples said gas supply line with said enclosed liquid reservoir second inlet so that upon actuation of said quick opening valve pressurized gas from said gas supply line applies pressure to liquid within said enclosed liquid reservoir to expel liquid through said acceleration tube and out said nozzle as a pulsed liquid jet.

3. Apparatus as claimed in claim **1** in which said quick opening valve is within said acceleration tube so that upon actuation of said quick opening valve liquid within said enclosed liquid reservoir is expelled through said acceleration tube and out said nozzle as a pulsed liquid jet under pressure of gas from said gas supply line.

4. Apparatus as claimed in claim **1** further comprising a piston within said enclosed liquid reservoir and intermediate the first valved inlet and the second inlet so that upon actuation of the quick opening valve gas from the gas supply line applies pressure through the piston to expel liquid from said enclosed liquid reservoir through said acceleration tube and out said nozzle as a pulsed liquid jet.

5. Apparatus as claimed in claim **2** further comprising a piston within said enclosed liquid reservoir and intermediate the first valved inlet and the second inlet so that upon actuation of the quick opening valve gas from the gas supply line applies pressure through the piston to expel liquid from said enclosed liquid reservoir through said acceleration tube and out said nozzle as a pulsed liquid jet.

6. Apparatus as claimed in claim **3** further comprising a piston within said enclosed liquid reservoir and intermediate the first valved inlet and the second inlet so that upon actuation of the quick opening valve gas from the gas supply line applies pressure through the piston to expel liquid from said enclosed liquid reservoir through said acceleration tube and out said nozzle as a pulsed liquid jet.

7. Apparatus as claimed in claim **1** in which said gas supply line includes a gas accumulator for accumulating gas for one operation of said apparatus.

8. Apparatus as claimed in claim **1** in which said first valved inlet and said second inlet each communicate with said enclosed liquid reservoir adjacent the top thereof and in which said acceleration tube inlet is within said enclosed liquid reservoir adjacent the bottom thereof to permit entry of liquid into said reservoir through said first valved inlet and application of pressurized gas through said second inlet onto liquid within said enclosed liquid reservoir to force liquid within said reservoir out said acceleration tube.

9. Apparatus as claimed in claim **4** in which said valved inlet communicates with said enclosed liquid reservoir adjacent the top thereof and said second inlet communicates with said enclosed liquid reservoir adjacent the bottom thereof to permit entry of liquid into said reservoir on the first side of said piston and entry of pressurized gas into said reservoir on the second side of said piston to raise said piston and expel liquid out said acceleration tube.

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