86-20.15 CA
F5786 OR 1,946,780
Examiner

Feb. 13, 1934. J. C. COSTELLO 1,946,780

POWDER LOADING DEVICE

Filed July 16, 1932 2 Sheets-Sheet 1

Fig. 1.

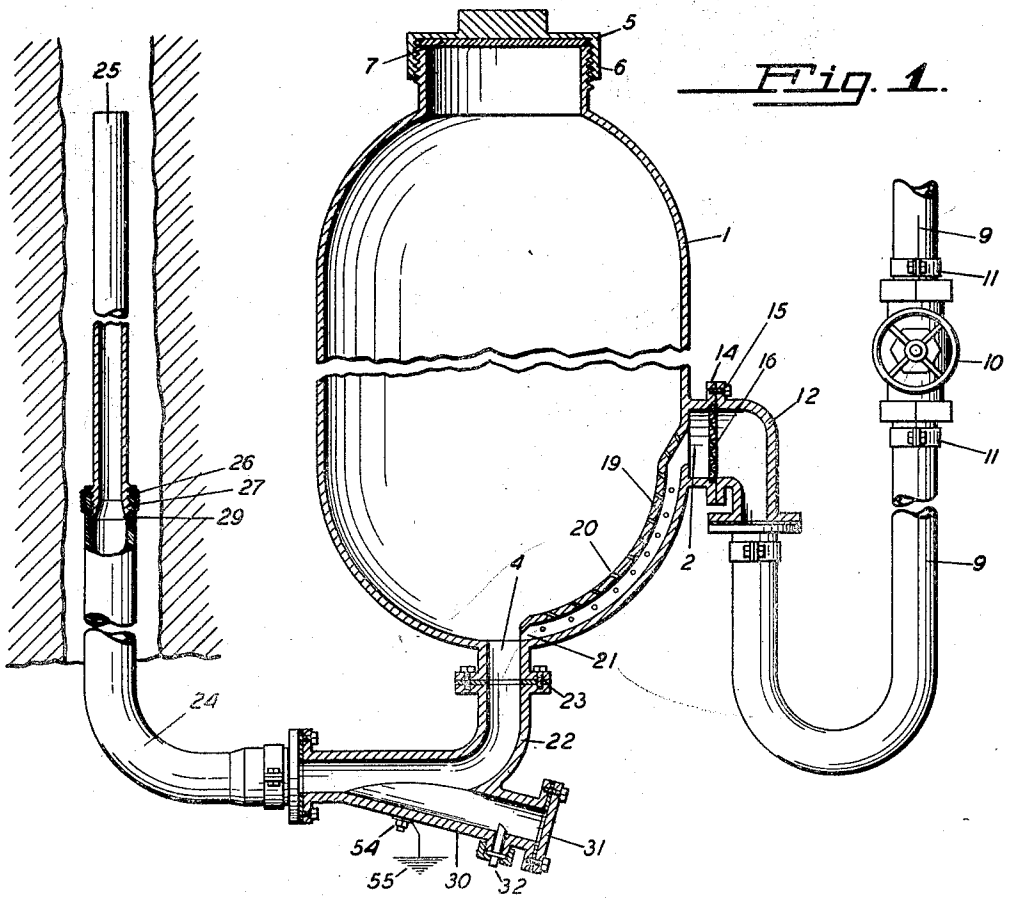
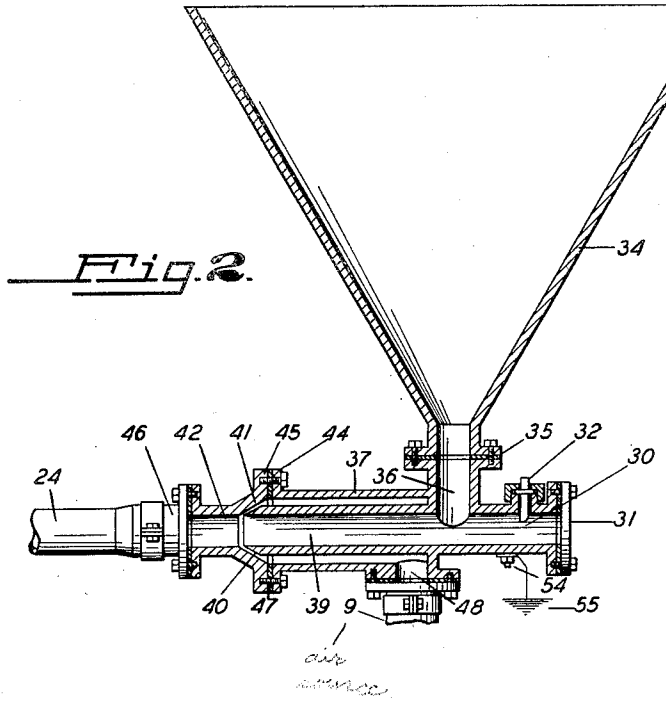


Fig. 2.



INVENTOR,
JOSEPH C. COSTELLO.
BY Donald K. Lippincott
ATTORNEY

86. AMMUNITION & EXPLOSIVE
CHARGE MAKING
20

Examiner

Feb. 13, 1934. J. C. COSTELLO 1,946,780

POWDER LOADING DEVICE

Filed July 16, 1932 2 Sheets-Sheet 2

Fig. 3.

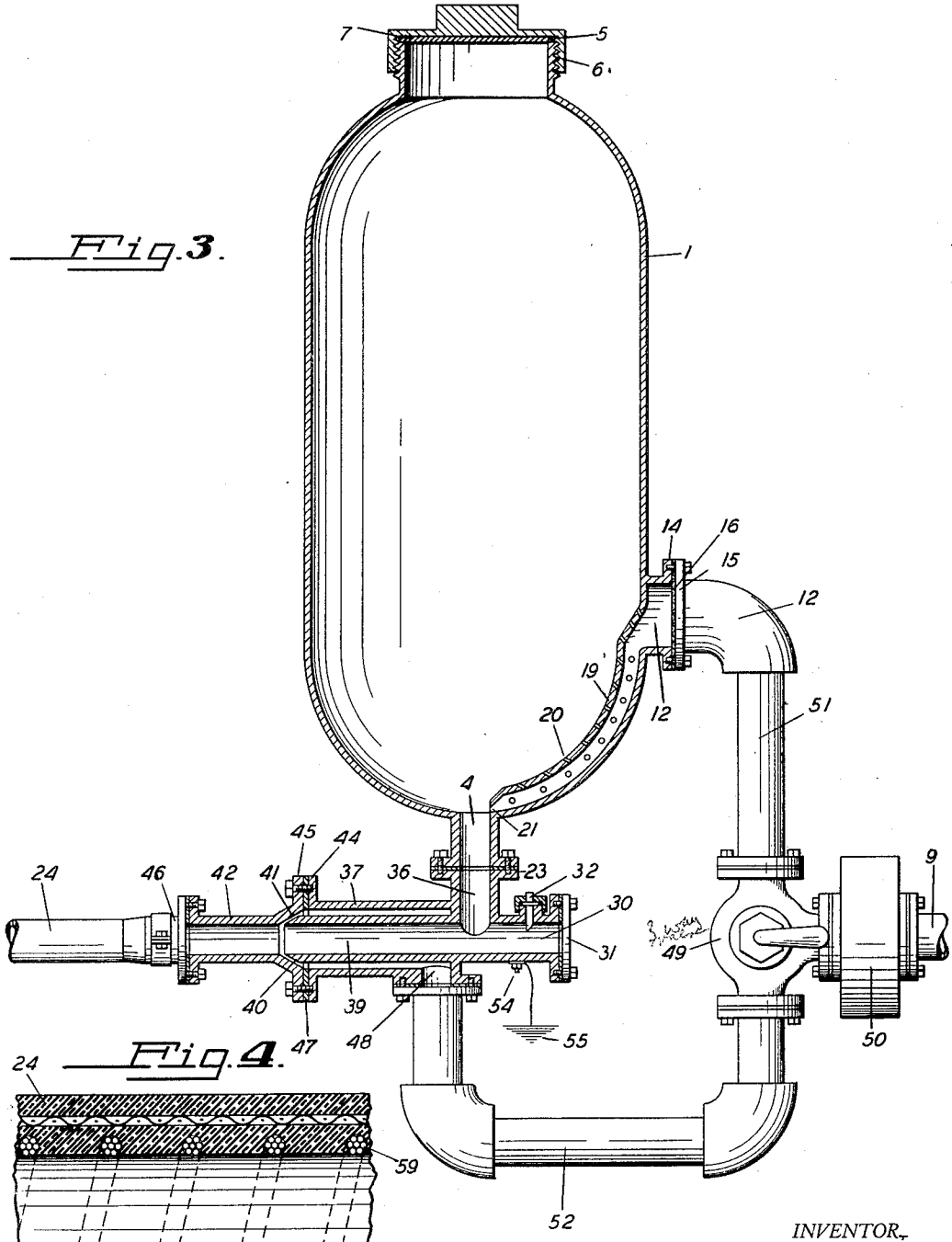


Fig. 4.

INVENTOR,
JOSEPH C. COSTELLO.
BY Donald K. Lippincott
ATTORNEY

86. AMMUNITION & EXPLOSIVE
CHARGE MAKING
20
Examiner

Patented Feb. 13, 1934

1,946,780

UNITED STATES PATENT OFFICE

1,946,780

POWDER LOADING DEVICE

Joseph C. Costello, San Francisco, Calif.

Application July 16, 1932. Serial No. 622,996

9 Claims. (Cl. 86—21)

My invention relates to apparatus for loading bore holes with explosives, and more particularly to improved injector apparatus for charging or withdrawing explosives in any form into or from bore holes by pneumatic means.

Among the objects of my invention are: To provide a means for rapidly filling a bore hole with explosives either in bulk or cartridge form; to provide an apparatus for charging a bore hole with pulverous explosives utilizing air as a conveying medium; to provide an apparatus for charging a bore hole with powder admixed with compressed air; to provide a compressed air injector for loading powder into blow holes which will minimize the danger of premature explosions; to provide a device for machine loading stick explosives into bore holes; and to provide means for slitting the wrapper of stick explosives while being loaded by compressed air into bore holes.

Other objects of my invention will be apparent or will be specifically pointed out in the description forming a part of this specification, but I do not limit myself to the embodiment of my invention herein described, as various forms may be adopted within the scope of the claims.

In the following description and claims it will be understood that the term "bore holes" refers to what are known in the art as hand holes, snake holes, well-drill holes, coyote and tunnel holes, and in particular to any holes or pockets where any type of explosive material is intended to be used.

Referring to the drawings:

Figure 1 is a sectional view, partly in elevation, of the powder loading device for mixing compressed air and pulverous explosive.

Figure 2 is a sectional view of an alternative form of powder receptacle and injector design.

Figure 3 is a view, partly in section, of a loading device utilizing both a pressure feed and injector action.

Figure 4 is a cross sectional view of a preferred form of delivery hose.

In broad terms, my invention for loading bore holes with explosives comprises a powder receptacle in which powder is mixed with compressed air and from there blown into the bore holes accompanied by a substantial dilution of free air in order to prevent slugs or stoppages by the compaction of powder in the delivery pipe. I also provide a side entrance, normally closed, to the delivery pipe, in which a cartridge or explosive in stick form may be inserted, to be conveyed into the hole, either as a detonator for a previously loaded granular charge, or as a portion of a complete charge of sticks. Means are provided in the stick entrance to slit the wrapper in order that the charges may be compacted more fully when they reach the bottom of the hole. I also reverse the injector action to unload a hole, and positively ground the entire device including the delivery hose to prevent premature detonation of the charges by static electricity accumulations, and as I have found that nails, small rocks and other hard objects are common in air supply lines I have provided a screen filter to remove such objects before they can enter the powder receptacle and cause explosions by impact. I have also removed all valves, threads and moving parts from danger of firing the powder by friction.

A preferred form of my device is shown in the figures. A powder receptacle 1 is provided with an air inlet 2, an air outlet 4, and an air-tight cover 5. It will be noted that I place the threads 6 on the outside of the receptacle in order that no powder grains may be caught in them and ignited by the screwing down of the cover, and I provide a leather or other soft gasket 7 under the cap for further protection. I also prefer to use a high pitch thread of few turns.

An air-supply hose 9 coming from an air compressor is provided with a control valve 10 attached by hose clamps 11. I have found it safer to place the control valve at some distance from the receptacle and to continue the supply hose to a filter fitting 12 which is bolted or otherwise fastened to a air inlet flange 14. At this point I include between the filter-fitting flange 15 and the inlet flange a fine mesh filter screen 16. This screen prevents foreign bodies in the air line from entering the receptacle, and also prevents powder from sucking back into the supply line in case of failure of the air supply.

Covering the air inlet is a distributing flange 19 only partially covering the inner surface, but extending down to the air outlet. This distributor is perforated with holes 20 so as to throw air in all directions throughout the receptacle and stir up the contained powder, and also has a free air port 21 located directly at the outlet so as to direct at least 20 percent of free air unmixed with powder directly into the outlet port.

No matter how compact the powder is above the outlet, it cannot be shot through the port as a single slug even though the distributor holes should fail to mix air with the contained powder,

as the 20 per cent of free air will break up any tendency for solid masses to pass out of the receptacle.

Referring directly to Figure 1, the powder is then forced by air pressure into the outlet elbow 22 fastened to the receptacle by flanges 23 and from there into a pliable delivery blowpipe 24 which is terminated by a delivery tip 25. I prefer to make this pipe from fiber or hard rubber, and the hose of rubber-canvas combination. I also prefer to provide the hose end of the tip with threads 26 where it enters the hose and wind the outside of the delivery hose with soft copper wire 27 to avoid any possibility of the tip becoming disconnected in use. A beveled surface 29 gives an easy gradation of surface between the hose and the tip.

In this particular embodiment I provide the outlet elbow 22 with a cartridge container 30 entering below the bend at a slight angle and closed with an air-tight flange 31.

After a charge of powder has been loaded the flange 31 may be removed and a detonating stick may be inserted into the delivery pipe. Upon the closure of the flange 31 the stick is picked up by the air flow and transferred to the top of the previously loaded charge.

In case it is desired to load stick powder exclusively no granular powder is placed in the receptacle and all loading is done through the cartridge container. It is customary when loading sticks to be tamped later, to slit the stick wrapper by hand before loading. I have found that by inserting a knife 32 in the wall of the cartridge container that stick wrappers will be automatically slit as they are inserted into the container, thus saving a great deal of labor.

For deep holes where it is not practical to force powder by direct pressure I have provided an injector as shown in Figure 2. Here I have shown an alternative form of receptacle or hopper 34 open to the air. I prefer to make the flange 35 on this hopper identical with flange 23 on receptacle 1 so that they may be interchanged. Injector inlet port 36 is preferably formed integral with injector casing 37 and leads into an injector nozzle 39 contained within the injector casing and extending slightly beyond the casing. The extended end of the nozzle is provided with a beveled surface 40 which cooperates with a cone surface 41 formed on the inner bore of an injector fitting 42. This fitting is attached to the injector casing flanges 44 by fitting flanges 45 and to the delivery hose 24 by the connection block 46.

A gasket 47 is placed between the flanges 44 and 45 and by inserting gaskets of varying sizes the cone surface 41 is variably spaced from the beveled surface 40 on the end of the nozzle, thus adjusting and providing for change in the injector suction.

The bore of the nozzle is extended on the other side of inlet port 36 to form a cartridge container 30 similar in all respects to that described in conjunction with Figure 1, and used to load sticks.

Air from the compressor hose 9 is supplied by an injector air port 48, to the annular chamber formed between the nozzle and the casing, passes through the venturi formed by the two surfaces at the end of the nozzle, creating a suction which pulls the powder from the hopper into the blowpipe tube, which will then deposit the powder.

Figure 3 shows the receptacle described in Figure 1 used in conjunction with the injector shown in Figure 2. As all necessary flanges are interchangeable, such a combination is quickly made in the field. The apparatus as shown in this figure is capable of handling all types of explosives whether sticky, gummy, lumpy, or formed into sticks.

A three-way valve 49 is connected to the air-supply line through a filter 50 similar to the one next to the powder receptacle, which keeps foreign bodies from entering the valve. The air is split by the valve and passes into the receptacle through receptacle pipe 51 and to the injector by the injector pipe 52.

The filter as described in Figure 1 is also used adjacent the powder receptacle to prevent grains from reaching back to the valve 49. No filter has been provided for the injector pipe line as it has been found that the powder will not back up through the Venturi passage.

Air is so proportioned that powder is forced from the receptacle into the injector nozzle, is there caught by the suction, passed into the delivery pipe and thence blown to its destination. The combined suction of the injector, and the expulsive force of the receptacle produces a steady progression of explosive material, which, when deposited may be detonated by a cartridge inserted through the cartridge chamber.

Connection block 46 on the delivery pipe, being identical in size and interchangeable with the air-tight flange 31 on the cartridge container, may be substituted for it, whereupon the injector will cause a suction to be exerted on the contents of the bore hole. Water may thus be removed, or, if desired, a previously loaded charge of powder may be extracted.

It is of course imperative that all metal parts be made of a metal which will not cause friction sparks. Copper and brass have been found satisfactory in this regard.

I have also determined that the factor of safety may be greatly increased by grounding all portions of the injector, to dissipate static charges formed by friction of the powder particles on the walls of the device. I have therefore provided a ground connection post 54 on all the assemblies so that connection may be made to ground as indicated by the symbol 55.

While not always necessary, there are certain types of powder with which I prefer to use a certain type of hose shown in Figure 4. The hose 24 is preferably formed of rubber 56 with a fabric reinforcement 57 vulcanized in the wall. In addition I embedded a stranded soft copper wire 59 spirally into the inner surface. This wire serves to drain off static charges from the interior of the hose, and as the surface of the wire is flush with the bore of the hose, but not covered by the rubber, the wire will automatically make contact with the connection block 46 and charges may then escape to ground through the body of the apparatus and the ground connection.

Efficient and economical results have been obtained in practice, my device functioning with perfect operational safety from premature explosions with all types of pulverous, granular or gummy explosives without the necessity of screening, sifting or otherwise treating the explosives as delivered by the makers, and with stick explosives used as a complete charge, or as detonators for a previously loaded pulverous charge.

CHARGE MAKING
20

It is also obvious that sand, dirt or like substances may be loaded on top of a charge for tamping purposes, the action being exactly the same as when pulverous explosives are used.

I claim:

1. Means for the loading of bore holes with explosives including a detonating cartridge comprising a compressed air injector, a powder receptacle, a source of compressed air, a blow pipe for conveying said explosives from said receptacle to a bore hole by the action of said air, and means associated with said receptacle for injecting said cartridge into said blow pipe.

2. Means for the loading of bore holes with stick explosives including a wrapper comprising a compressed air line adapted to extend into the hole, a receptacle outside of said hole through which said stick may be fed to said line, and means in said receptacle to slit said wrapper as said stick passes into said line.

3. Means for the loading of bore holes with stick explosives including a wrapper comprising a compressed air line adapted to extend into the hole, a receptacle outside of said hole through which said stick may be fed to said line, and a knife supported by the inner wall of said receptacle to slit said wrapper as said stick passes into said line.

4. In combination with a powder receptacle, a delivery pipe, a source of compressed air, an injector comprising a casing connected to said source, a nozzle connected to said receptacle mounted inside of said casing, means for connecting said delivery pipe to said casing, said means cooperating with the end of said nozzle to cause a restriction of air from said source where a suction is formed which moves the powder in said receptacle into said delivery pipe, and means for inserting a detonating cartridge in said nozzle.

5. In combination with a powder receptacle, a delivery pipe, a source of compressed air, an injector comprising a casing connected to said source, a nozzle connected to said receptacle mounted inside of said casing; means for connecting said delivery pipe to said casing, said means cooperating with the end of said nozzle to cause a restriction of air from said source whereby a suction is formed which moves the powder in said nozzle into said delivery pipe, means for supplying a portion of said air to said receptacle to cause said powder to be forced out of said receptacle into said nozzle, and means for inserting a detonating cartridge in said nozzle.

6. Means for servicing bore holes adapted to be loaded with explosives by a blowing process, which comprises a powder receptacle, a blow-pipe extending into the hole, a compressed air injector attached to said receptacle, and a fitting on the suction end of said injector whereby said blow-pipe may be attached to unload said hole.

7. Means for the complete loading of bore holes with explosives in pulverous form, said loading including a detonating cartridge, comprising a compressed air injector, a powder receptacle, a receptacle for said cartridge, and a pliable hose connected to said injector and serving at the same time as a conveyor for the compressed air with the explosive suspended therein and for said detonating cartridge.

8. Means for the loading of bore holes with explosives comprising a compressed air injector, a delivery pipe attached to said injector, said delivery pipe being formed of insulating material and having a continuous conductor embedded therein adjacent and exposed to the bore of said pipe.

9. Means for the loading of bore holes with explosives comprising a compressed air injector, a delivery pipe attached to said injector, said delivery pipe being formed of insulating material and having a continuous conductor embedded therein adjacent and exposed to the bore of said pipe, said conductor being grounded.

JOSEPH C. COSTELLO.