Nov. 18, 1924. 1,516,343

T. F. KNIGHT

METHOD AND APPARATUS FOR UNLOADING HIGH EXPLOSIVE SHELLS

Filed June 13, 1924

Fig.1.

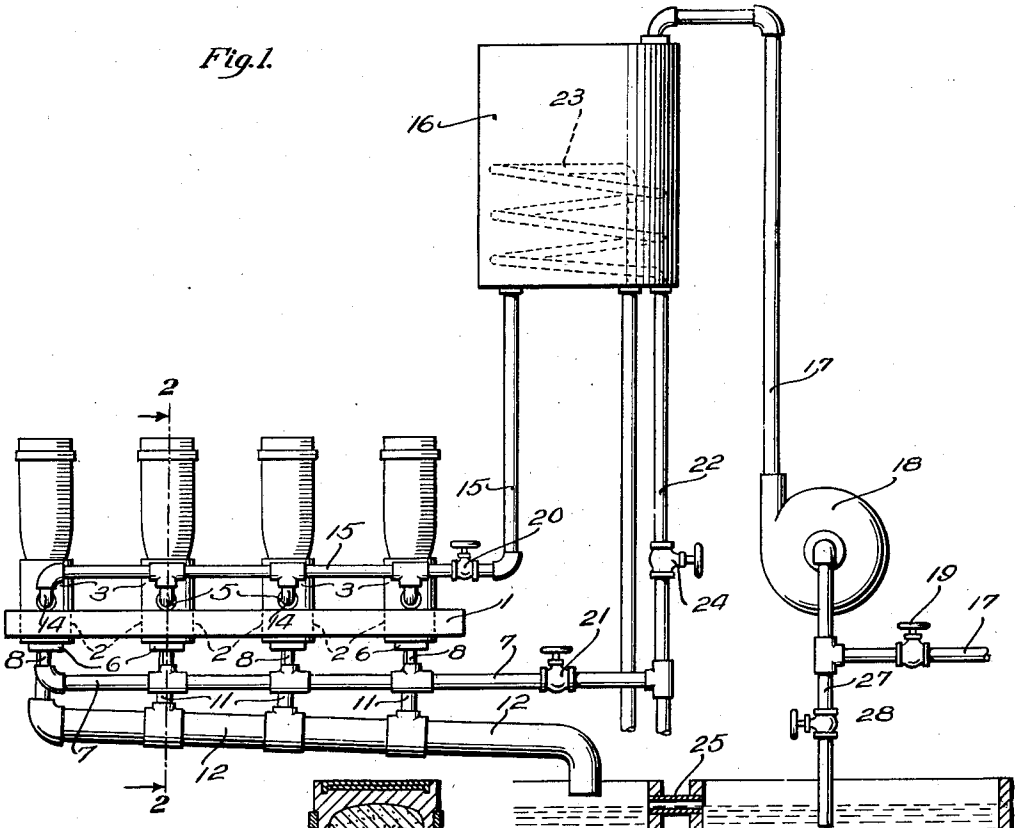


Fig.2.

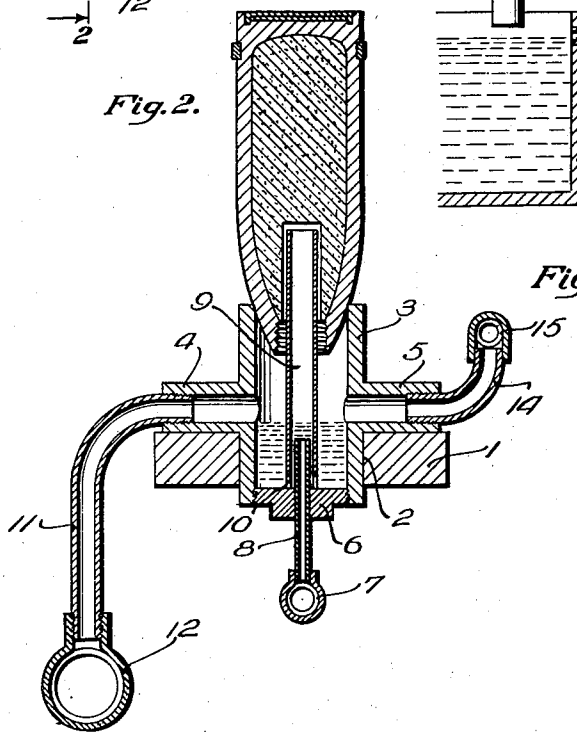


Fig.3.

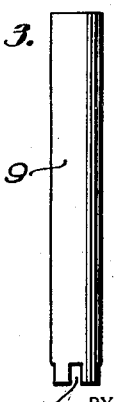
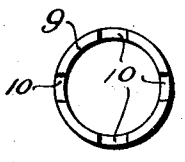


Fig.4.



INVENTOR
Thomas F. Knight.
BY Daniel Davis
ATTORNEYS

Patented Nov. 18, 1924. 1,516,343

UNITED STATES PATENT OFFICE.

THOMAS F. KNIGHT, OF LYNDHURST, NEW JERSEY, ASSIGNOR TO COLUMBIA SALVAGE CORPORATION, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK.

METHOD AND APPARATUS FOR UNLOADING HIGH-EXPLOSIVE SHELLS.

Application filed June 13, 1924. Serial No. 719,767.

To all whom it may concern:

Be it known that I, THOMAS F. KNIGHT, a subject of the King of Great Britain, and resident of Lyndhurst, in the county of Bergen and State of New Jersey, have invented certain new and useful Improvements in Methods and Apparatus for Unloading High-Explosive Shells (Case No. 14), of which the following is a specification.

The main object of this invention is to provide a new and useful method and apparatus for unloading high-explosive shells and separating and recovering the materials forming the high-explosive charge. It is necessary that the entire high-explosive charge be removed from the shells in order that the empty shells may be safely melted or reduced in a blast furnace or otherwise. These shells are of high quality steel and are valuable provided the explosive charge is entirely removed. When the high-explosive charge is a mixture of several different kinds of material it is desirable to separate those materials after the charge has been removed from the shell, in order to render such materials separately available for commercial purposes.

A high-explosive shell for artillery use consists, ordinarily, of a hollow steel shell filled with a charge of high explosive. The shell is usually pointed at one end, and said pointed end is known as the nose. In the nose is formed a longitudinally extending threaded aperture in which is screwed a flange adapter ring, said ring carrying a booster casing which extends into the shell and contains the so-called booster charge. The fuse, or fuse stock, is screwed into the adapter ring and this also carries a small charge of explosive within the booster casing. A great many of these high explosive shells are charged with amatol. Amatol is a mixture of ammonium nitrate and trinitrotoluol (TNT) in proper proportions. It is fluid or semi-fluid at certain temperatures and may be readily poured into the shell. It cools and solidifies within the shell and becomes a substantially solid mass of material which completely fills the entire shell except for a small space at the nose, which is designed to receive the booster casing. Other similar high explosives are used, such as pure TNT. The main purpose of this invention is to provide a method and apparatus for safely, completely and quickly removing the amatol from the shells and separating it into TNT and ammonium nitrate. The process is also adapted for use in removing TNT and other similar high explosive charges from shells.

In the drawing Fig. 1 is a diagrammatic side elevation, partly in section, of an apparatus for carrying out the invention;

Fig. 2 an enlarged sectional view on the line 2—2 of Fig. 1;

Fig. 3 a detail side elevation of one of the spray nozzles of the apparatus; and

Fig. 4 a view showing the lower end of the spray nozzle.

In carrying out this invention the adapter ring and the booster casing are first removed thereby leaving the threaded aperture in the nose of the shell open so that access may be had therethrough to the interior of the shell. When the booster casing is removed the booster cavity in the explosive charge is open to and axially in line with the threaded aperture in the shell.

The form of the apparatus shown in the drawing comprises a horizontally disposed plank 1, formed with a series of circular openings 2 arranged on a straight line extending longitudinally of the plank. In each of the openings 2 in the plank is fitted the lower end of a vertically disposed cylindrical casing 3. The casing 3 is in the form of a pipe union and is provided intermediate its length with oppositely extending branches 4 and 5 of relatively small diameter. The branches 4 and 5 are adapted to rest upon the upper face of the plank 2 and hold the casing in place within the hole 2. The lower end of the casing is closed by a threaded plug 6 and the upper end of the casing is open and adapted to receive and snugly engage the tapered end of a shell and support the said shell in an upright position with its lower end extending down into the casing. A steam supply pipe 7 extends longitudinally beneath the supporting plank 1 and said pipe has a series of steam jet nozzles 8 extending upwardly therefrom. Each of the nozzles 8 extends upwardly through an opening in the center of the casing plug 6 into the casing and has its upper end open and disposed in vertical alinement with the open end of a shell when the shell is supported by the casing. A tubular spray nozzle 9 is disposed within the casing 3 with its lower end surrounding the upper end of

the steam jet nozzle 8 and resting upon the plug 6, and with its upper end extending above the upper end of the casing into the booster cavity of the shell for substantially the length of the said cavity. The spray nozzle 9 rests loosely upon the plug 6 and may be readily removed from the casing to give access to the jet nozzle 8 or to clean the spray nozzle. While the casings 3 are shown and described as mounted upon a plank, it is obvious that other suitable means for supporting the casings could be used.

The openings through the branches 4 and 5 of the casing 3 are spaced a material distance above the bottom of the casing formed by the plug 6 and also above the upper end of the steam jet nozzle 8. A well which is adapted to contain liquid is thus formed in the casing below the branch 4. The spray nozzle 9 is materially larger in diameter than the steam jet nozzle which it surrounds and is formed at its lower end with apertures or notches 10 through which the liquid in the well is adapted to circulate. The branch 4 provides an overflow for the well and governs the height of the liquid level therein. When the liquid rises to the level of the branch 4 the upper end of the steam jet nozzle within the spray nozzle will be submerged with liquid to the proper depth. A pipe 11 leads downwardly from the branch 4 of each of the casings 3 and connects with an inclined drain pipe 12. The pipe 12 empties into a settling tank 13. The branch 5 of each of the casings 3 connects by means of an upwardly extending elbow 14 to a liquid supply pipe 15 which leads from an elevated tank 16 and is adapted to supply liquid to the wells in the casing 3. The tank 16 is adapted to receive water from a source, not shown, through a pipe 17, the water being elevated to the tank by a suitable pump 18. The flow of water to the pump is regulated by means of a valve 19 and the flow of liquid from the tank 16 to the casings 3 is regulated by means of a valve 20 in the supply pipe 15. The steam supply to the steam jet nozzles is regulated by means of a valve 21 in the steam supply 7. A branch pipe 22 leads upwardly from the pipe 7 and is adapted to supply steam to a heating coil 23 within the tank 16, whereby the liquid is heated before its delivery to the wells in the casings 3. The supply of steam to the heating coil 23 is regulated by means of a valve 24 in the pipe 22. The tank 13 is connected by means of an overflow duct 25 to a second tank 26 and leading upwardly from the tank 26 is a pipe 27 provided with a valve 28 and connected at its upper end to the part of the water pipe 17 which leads to the pump 18.

In operation the steam jets from the nozzles 8 blow up through the spray nozzles 9 and into the booster cavities in the explosive charges. Some of the steam will be condensed and the hot water thus formed will flow down into the wells in the casings 3. Some of the material of the charge will be liquefied and will flow down from the shells and into the wells. As the liquid accumulates in the wells it will flow through the notches 10 into the spray nozzles and as it rises therein above the steam jet nozzles 8 it will be blown up into the shells by the steam jets. The hot liquid thus blown up into the shells and swirled around therein by the steam will assist greatly in softening and liquefying the explosive charge. When the wells in the casing are full the surplus liquid will overflow into the pipe 12 and from thence into the tank 13. In order for the charges to be properly liquefied and removed from the shells at a rapid rate it is necessary that a certain amount of moisture be delivered by the spray nozzles. If the steam that is delivered to the jet nozzles is very dry the moisture will be insufficient to liquefy the charges at the proper rate. In this case liquid from the tank 16 may be supplied to the casing wells and the nozzles. Through the means of the valve 20 the delivery of liquid may be properly regulated. At the beginning of the operation the shell is cold, the steam condensation therein is rapid and very little or no liquid need be supplied to the nozzles, but as the operation progresses the shells become heated, there is less moisture from condensation, and more liquid may then be supplied by opening valve 20. In this manner the liquid can be kept at the proper depth in the casing wells to submerge the steam jet nozzles and insure the delivery of the proper amount of moisture.

The charge that falls from the shells consists of a mixture of liquefied TNT and a solution of ammonium nitrate and water. This mixture flows through the pipe 12 to the tank 13, wherein the TNT being of greater specific gravity will be precipitated to the bottom and the ammonium nitrate solution will overflow from the tank 13 through the duct 25 to the tank 26. It is desirable for commercial reasons that the ammonium nitrate solution be of a certain strength, and it may happen that owing to the delivery of too much water to the shells, through the spray nozzles or through condensation of the steam, that the strength of the solution falls below the standard. This difficulty may be readily overcome by closing the valve 19 in the water pipe 17 leading to the pump 18, and opening the valve 28 in the pipe 27 leading from the ammonium nitrate solution tank 26 to the pump. Ammonium nitrate solution will then be delivered to the tank 16, where it will be heated and delivered to the casings 3 and the spray nozzles in accordance with the ad-

justment of the feed valve 20. By a proper adjustment of the different valves to cut down the water supply and re-circulate the nitrate solution, as described, the strength of the solution in the tank 26 may be built up to the required degree.

What I claim is:

1. An apparatus for liquefying and removing a solidified charge from a shell, comprising a casing formed with a circular opening in its upper end and adapted to hold a shell in an upright position with its open tapered end fitting in said circular opening and extending downwardly into the casing, and an upwardly directed steam jet nozzle within the casing in vertical alinement with the open end of the shell, the casing being formed with a well in its lower end adapted to contain liquid and formed with an overflow drain opening above the level of the upper end of the steam jet nozzle, whereby the nozzle is adapted to be submerged by the liquid in the well.

2. An apparatus for liquefying and removing a solidified charge from a shell, comprising a casing having a circular opening in its upper end and adapted to hold a shell in an upright position with its open tapered end fitting in said circular opening and extending downwardly into the casing, an upwardly directed spray nozzle within the casing and adapted to extend upwardly into the shell through the open lower end thereof, and a steam jet nozzle extending up into the spray nozzle, the casing being formed with a well in its lower end adapted to contain liquid and formed with an overflow drain opening above the level of the upper end of the steam jet nozzle whereby the nozzle is adapted to be submerged by the liquid in the well.

3. An apparatus for liquefying and removing a solidified charge from a shell, comprising a casing formed with a circular opening in its upper end and adapted to hold a shell in an upright position with its open tapered end fitting in said circular opening and extending downwardly into the casing, an upwardly directed steam jet nozzle within the casing in vertical alinement with the open end of the shell, the casing being formed with a well in its lower end adapted to contain liquid and formed with an overflow drain opening above the level of the upper end of the steam jet nozzle whereby the nozzle is adapted to be submerged by the liquid in the well, a pipe connected to the casing to supply liquid to the well, and a valve to regulate the flow of liquid through the pipe.

4. An apparatus for liquefying and removing a solidified charge from a shell, comprising a casing adapted to support a shell in an upright position with its open end extending downwardly into the casing, an upwardly directed steam jet nozzle within the casing in vertical alinement with the open end of the shell, the casing being formed with a well in its lower end adapted to contain liquid and formed with an over-flow drain opening above the level of the upper end of the steam jet nozzle whereby the nozzle is adapted to be sumerged by the liquid in the well, and valve controlled means for delivering liquid to the well from either or both of two different sources.

5. An apparatus for liquefying and removing a solidified charge from a shell, comprising a casing adapted to support a shell in an upright position with its open end extending downwardly into the casing, an upwardly directed steam jet nozzle within the casing in vertical alinement with the open end of the shell, a steam supply pipe connected to said nozzle, the casing being formed with a well in its lower end adapted to contain a liquid and formed with an over-flow opening above the level of the upper end of the steam jet nozzle whereby the nozzle is adapted to be submerged by the liquid in the well, a pipe adapted to deliver liquid to the well, a valve for regulating the flow through said pipe, means for heating the liquid prior to its delivery to the well, and valve regulated means adapted to deliver liquid to the said heating means from either or both of two different sources.

6. An apparatus for liquefying and removing a solidified charge from a shell, comprising a vertically disposed cylindrical casing, the lower end of said casing being closed and the upper end being open and adapted to support a shell in an upright position with its open tapered end fitting in said opening and extending downwardly into the casing, a tubular spray nozzle adapted to extend upwardly from the lower closed end of the casing and into the lower open end of the shell, and a steam jet nozzle extending upwardly into the casing and into the lower end of the spray nozzle, said casing being adapted to contain liquid in its lower end surrounding the steam jet nozzle and formed with a liquid supply opening and a drain opening, said drain opening being located above the upper end of the steam jet nozzle and the lower end of the spray nozzle being provided with apertures, whereby the steam jet nozzle is adapted to be submerged by liquid.

7. The method of removing a solidified charge of amatol from a shell consisting in placing the shell with its open end directed downwardly, directing a spray nozzle into the open end of the shell, confining a small body of liquid around the spray nozzle and maintaining said liquid at a constant level, directing a jet of steam up through the spray nozzle and into the shell whereby the charge will drop from the shell in the form of

liquefied TNT and ammonium nitrate solution, separating the ammonium nitrate solution from the TNT, and re-circulating separated ammonium nitrate solution to the said body of liquid surrounding the spray nozzle.

8. An apparatus for liquefying and removing a solidified charge from a shell, comprising means for supporting a shell in an upright position with its open end downward, a steam supply pipe, an upwardly directed steam jet nozzle in vertical alinement with the open end of the shell and connected to the steam supply pipe, a well adapted to contain liquid surrounding the jet nozzle and adapted to permit the liquid to over-flow therefrom above the level of the upper end of the nozzle, and means independent of the steam jet nozzle to supply liquid to the well to keep the upper end of the nozzle submerged.

9. An apparatus for liquefying and removing a solidified charge from a shell, comprising a casing having a circular opening in its upper end and adapted to hold a shell in an upright position with its open tapered end fitting in said circular opening and extending downwardly into the casing, an upwardly directed tubular spray nozzle within the casing and adapted to extend upwardly into the shell through the open lower end thereof, and a steam jet nozzle extending up into the lower end of the spray nozzle, the casing being formed with a well in its lower end adapted to contain liquid and formed with an over flow opening above the level of the upper end of the steam jet nozzle and the said spray nozzle being materially larger in diameter than the jet nozzle and being loosely supported in the bottom of the well and formed with apertures at its lower end.

In testimony whereof I hereunto affix my signature.

THOMAS F. KNIGHT.