Dec. 6, 1949 L. E. WALKUP 2,490,108

APPARATUS FOR CONTINUOUSLY SEPARATING SOLIDS OF EXPLOSIVE FROM LIQUID

Filed March 24, 1942

Fig. 1.

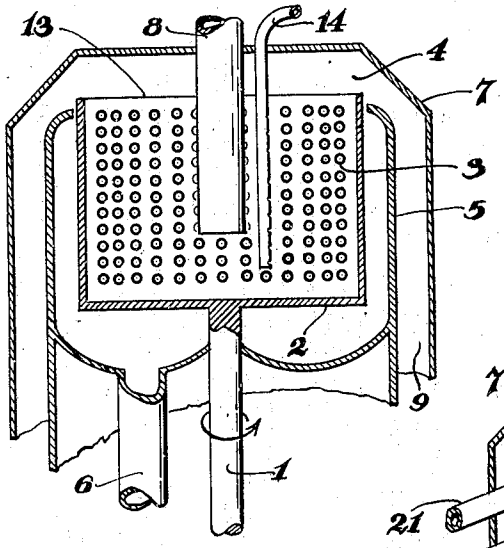


Fig. 3.

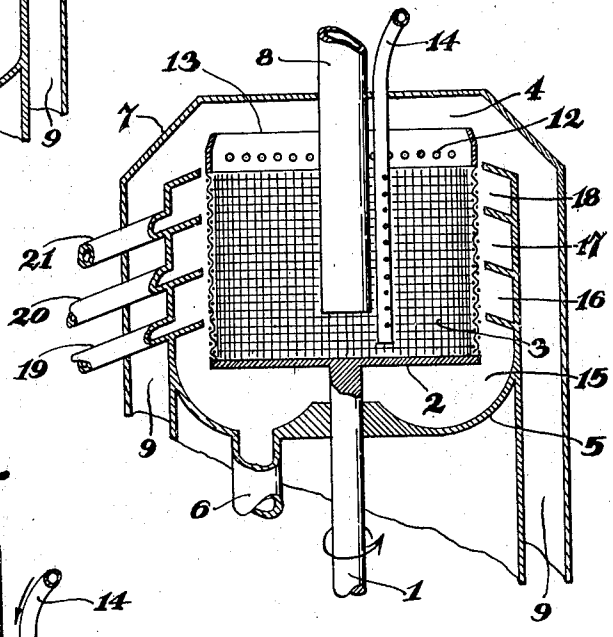
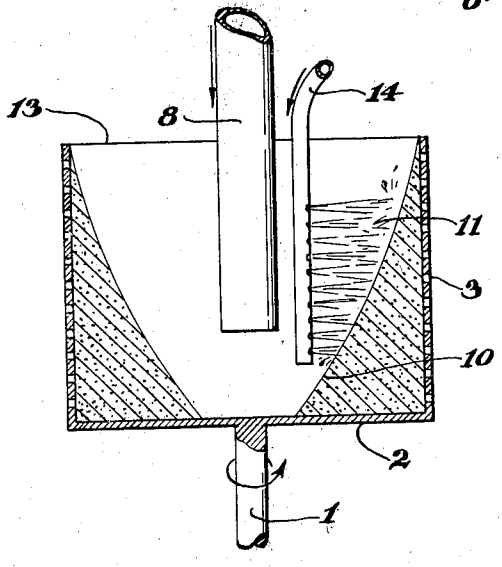


Fig. 2.



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APPARATUS FOR CONTINUOUSLY SEPARATING SOLIDS OF EXPLOSIVE FROM LIQUID

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5 Claims. (Cl. 210—66)

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This invention relates to the manufacture of explosives and in particular to the separation of explosive particles from a slurry.

In the manufacture of explosives, in accordance with some processes, small particles of the solid explosive are in contact with or suspended in large volumes of liquid and must be separated therefrom before they can be further treated or used.

Simple decantation methods are operative for this purpose only with explosives having a tendency to completely settle out of their liquid slurries and they have in addition the disadvantage of requiring appreciable periods of time for such settling out and offer difficulty in obtaining a complete separation of the liquid from the explosive.

Continuous vacuum type filters such as the rotary filter, and batch type separators, such as the intermittently operated centrifugal separators, have been employed for such purposes, but methods employing such filters are attended with serious disadvantages in the manufacture of explosives, chief among which may be mentioned high cost of operation, low production capacity, and in the case of the continuous vacuum type filter, difficulty in control due to the critical proportions of slurry necessary for satisfactory functioning.

It is an object of this invention to provide a process for economically securing effective separation of particles of explosive from a liquid.

Another object of the invention is to provide a rugged and uncomplicated centrifugal apparatus for continuously separating the components of a slurry composed of particles of explosive in a liquid.

Still another object of this invention is to provide an economical method and means for the continuous separation of particles of explosive from an associated liquid while affording opportunity for further treatment with a treating liquid during the separation process.

A still further object of the invention is to provide an economical method for continuously treating particles of explosive with a liquid for a very short period of time and thereafter separating the particles of explosive from the liquid.

Other objects will be apparent from the accompanying description and drawings, of which

Fig. 1 is a vertical section of a centrifugal separator embodying this invention, and

Fig. 2 is a vertical section of the rotary container illustrating the form taken by the explosive, and

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Fig. 3 is a vertical section of a modified centrifugal separator embodying the invention.

In accordance with the present invention the above stated objects are accomplished by continuously feeding a slurry of the explosive particles into a rapidly rotating container having substantially cylindrical perforated side walls, providing means for continuously collecting and discharging the liquid passing through the perforations, and providing means for continuously collecting and discharging the substantially liquid-free explosive propelled from the mouth of the container. When an intermediate treatment with a liquid is desired, means are provided for spraying wash water or other liquid toward the inner surface of the side walls of the container during the process.

It has now been found that if a slurry of explosive particles is fed continuously into a rapidly rotating container having substantially cylindrical perforated side walls, the explosive, as it loses its slurry liquid through the perforations, first forms a lining having a conoidal surface in the container and then subsequently fed particles climb along this surface and are propelled outwardly from the mouth of the container over the edge of the lining.

The lining of explosive has been found to serve as an ideal filter bed for the slurry, retaining explosive particles smaller than the perforations in the container walls and preventing larger particles from clogging the perforations.

Further, it has been found that the explosive may be washed or otherwise treated with a liquid by spraying the wash water or other liquid on the lining of explosive, particularly on the upper portion thereof, during the separating operation.

Thus, according to this invention, the slurry of explosive can be continuously fed into the rotating container, the liquid content thereof passing through the perforations and being diverted to the sewer or elsewhere as desired, while the particles of substantially liquid-free explosive are continuously propelled from the mouth of the container and can be collected and continuously conveyed away for further treatment or use.

A novel centrifuge developed for carrying out the process of this invention is illustrated in Figures 1, 2, and 3, in which a container 13 having an imperforate bottom 2 and cylindrical perforate side walls 3 is mounted for rotation about the longitudinal axis on a rotary shaft 1. A housing 5 is mounted about the perforate portion 3 of the container 13 and is adapted to collect the liquid passing through the perforations and

to discharge same through the outlet 6. The annular receptacle 4 with walls 7 and discharge outlets 9 is mounted about the mouth of the container 13 and is adapted to collect and discharge particles of explosive propelled from the mouth of the container 13. A feed pipe 8 is provided to inject the slurry of explosive into and near the bottom 2 of the container 13. Liquid inlet pipe 14 is provided to spray wash water or other liquid toward the side walls 3 of the container 13.

In Fig. 2, the line 10 illustrates the conoidal surface of the lining of the explosive in the container 13, and application of a treating liquid to the explosive is shown at 11.

In Fig. 3, a variation in the container 13 is illustrated in which a series of large perforations 12 are located at the mouth of the container 13 and above the perforate side walls 3. The perforations 12 are designed to permit passage of the substantially liquid-free explosive into the annular receptacle 4.

The housing 5 may be subdivided into one or more receptacles 15, 16, 17 and 18 with discharge outlets 6, 19, 20 and 21, for the purpose of separating the slurry liquid from the wash water, or other treating liquids, expelled from the side walls 3 of the container.

By way of illustration, following is a description of the use of the process and apparatus of this invention on substantially spherical particles of smokeless powder prepared for instance according to the process described in U. S. Letters Patent 2,027,114, wherein a powder base is suspended in water in the presence of a solvent for the powder base and after agitation and heating to remove the solvent, small spherical gelatinized grains of smokeless powder suspended in water result.

In separating such powder from its slurry liquid, a rotary container 13 about seven inches in diameter and six inches high was employed. The side walls 3 of the container were perforated with one quarter inch holes, all but the top annular row of holes 12 near the mouth of the container being covered with fine mesh Dutch-weave screen. A slurry containing about 50% by weight of powder was fed into the container near the bottom and a lining of powder having a conoidal surface was immediately built up in the container, the surface of the lining having an angle of about 25° to the sidewalls. Immediately after formation of the lining, substantially liquid-free powder was propelled from the container through the annular row of perforations 12 about the mouth of the container.

At the same time the powder slurry was being fed into the container, wash water was sprayed from inlet 14 onto about the upper half of the powder lining. In this way the powder, which lost its slurry liquid relatively near the bottom 2 of the container, was washed substantially free of any residual slurry liquid constituents while traveling up the surface of the lining through the spray of wash water to the perforations 12. Washing in this manner was found to be very efficient requiring only a small portion of water per unit weight of powder.

The liquid passing through the perforations, which included both the slurry liquid and the wash water, was diverted to a storage vessel for recovery of the treating reagents contained therein.

The powder propelled through the annular row of perforations 12 at the mouth of the container was substantially free of all but the occluded liquid and had an average moisture content of only about 9.5%. The container was rotated at the relatively low speed of about 800–900 revolutions per minute and even at this low speed the capacity was found to be about 35,000 pounds of liquid-free powder per 24 hours. The production capacity could be considerably increased by raising the speed of rotation. The continuous centrifugal separator required a much smaller space and only a fraction of a horsepower for operation whereas a vacuum type rotary filter having much lower production capacity was found to require about 22 horsepower. The effectiveness of this process is demonstrated by the fact that the 9.5% residual moisture content is the same as that obtained by centrifuging a lot of the same powder in a batch centrifuge for 4½ minutes at 1900 R. P. M.

Although in the above specific example, the process and apparatus of this invention are described for use on spherical gelatinized grains of smokeless powder it should be understood that the invention may also be employed with other explosive materials such as bulk smokeless powders, for instance made according to the process described in U. S. Letters Patent 2,235,298, tetryl and other explosive particles, particularly of substantially spherical or oval shape or agglomerates of roughly spherical configuration.

The process and apparatus of this invention may likewise be employed to continuously treat even substantially dry particles of explosive with one or more liquids for relatively short periods of time, in which case the particles of explosive may be fed, for instance through feed pipe 8, into the container simultaneously with the treating liquid, which may be fed through one or more inlets 14, while the treated and substantially liquid-free explosive is continuously propelled from the mouth of the container.

As shown in Figure 3, the process and apparatus may be readily adapted for maintaining a separation of the slurry liquid from the wash water or other treating liquid, which is of decided advantage in some instances for recovery or other purposes.

A distinct advantage in having the explosive material form the lining in the rotary container is that depending on its angle of repose each explosive forms its own slope at just the angle necessary to permit the particles to climb to the mouth of the container and an ideal filter bed for separating the explosive slurry is thereby provided. Further advantages as described above are increased economy of operation and increased production capacity.

Since many variations may be made in the specific embodiments described therein without departing from the spirit and scope of the invention, it should be understood that the invention is not limited to the details thereof except as set forth in the appended claims.

Having now described the invention, what is claimed as new and is desired to be covered by Letters Patent is:

1. Apparatus for continuously separating grains of explosive from an associated liquid, comprising the combination of a container having an imperforate bottom and substantially cylindrical perforate side walls with a conoidal-surfaced lining of said grains and mounted for rotation about its longitudinal axis, a housing mounted about said container and adapted to continuously collect and discharge liquid passing through the lining and perforate side walls of said container, an

annular receptacle mounted about the mouth of said container and adapted to continuously collect and discharge the substantially liquid-free grains of explosive propelled from the mouth of said container, and means for rotating said container.

2. Apparatus for continuously separating smokeless powder grains from a slurry thereof, comprising the combination of a container having substantially cylindrical perforated side walls with a conoidal-surfaced lining of said grains and mounted for rotation about its longitudinal axis, a housing mounted about said container adapted to continuously collect and discharge liquid expelled through the lining and perforations in said container, an annular receptacle mounted about the mouth of said container and adapted to collect and discharge the grains of explosive propelled from the mouth of said container, means for forcing a liquid toward the inner perforate surface of said container and means for rotating said container.

3. Apparatus for continuously separating grains of explosive from a slurry thereof, comprising the combination of a container having substantially cylindrical perforated side walls with a conoidal-surfaced lining of said grains and mounted for rotation about its longitudinal axis, a housing mounted about said container and provided with a plurality of compartments adapted to collect and separately discharge liquids expelled through the lining and perforated side walls of said container at different elevations, an annular receptacle mounted about the mouth of said container and adapted to collect and discharge the grains of explosive propelled from the mouth of said container, means for forcing liquid toward the inner perforate surface of said container, and means for rotating said container.

4. Apparatus for continuously separating grains of explosive from an associated liquid, comprising the combination of a container having an imperforate bottom and substantially cylindrical perforate side walls with a conoidal-surfaced lining of said grains and mounted for rotation about its longitudinal axis, a housing mounted about said container and adapted to continuously collect and discharge liquid ejected through the lining and perforations in said container, an annular receptacle having an outlet in its bottom mounted about the mouth of said container for continuously collecting and discharging the grains of explosive propelled from the mouth of said container, and means for rotating said container.

5. Apparatus for continuously separating grains of explosive from an associated liquid, comprising the combination of a container having an imperforate bottom and substantially cylindrical perforate side walls and mounted for rotation about its longitudinal axis, a porous lining of granular material in said container presenting a conoidal surface having a slope substantially equal to the angle of repose of the said grains of explosive, a housing mounted about said container and adapted to continuously collect and discharge liquid ejected through the lining and perforations in said container, a receptacle having an outlet in its bottom mounted about the mouth of said container for continuously collecting and discharging the grains of explosive propelled from the mouth of said container, and means for rotating said container.

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