Dec. 18, 1945. G. BRYCE ET AL 2,391,006

TRANSPORT OF AQUEOUS EMULSIONS OF LIQUID EXPLOSIVES

Original Filed Sept. 2, 1941 2 Sheets-Sheet 1

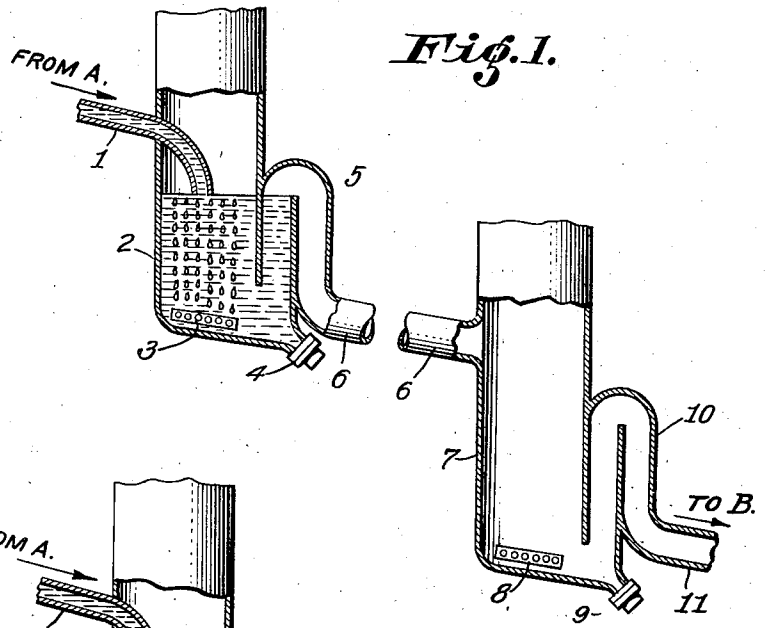


Fig. 1.

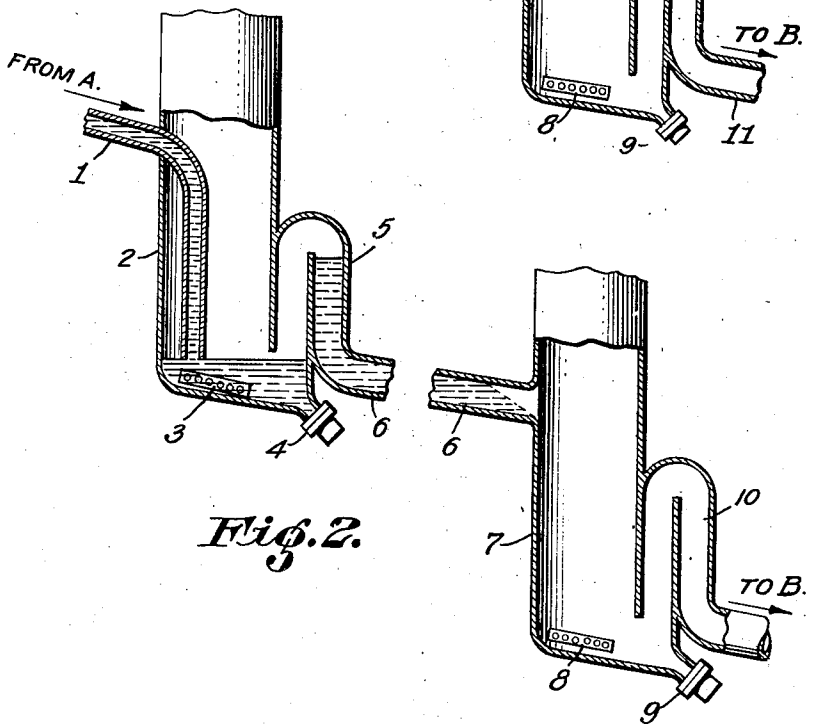


Fig. 2.

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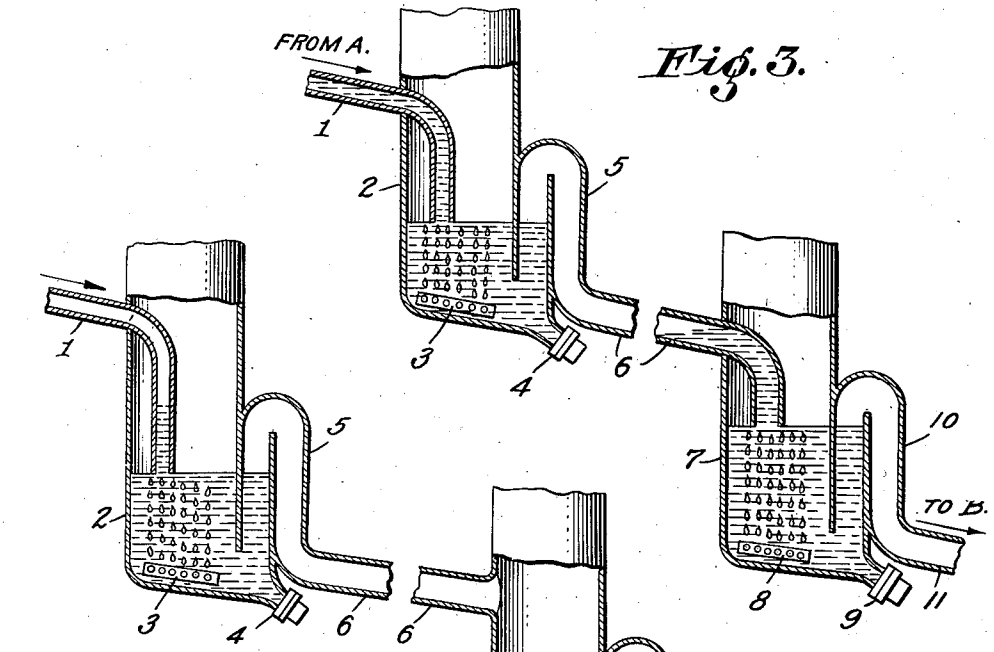


Fig. 3.

Fig. 4.

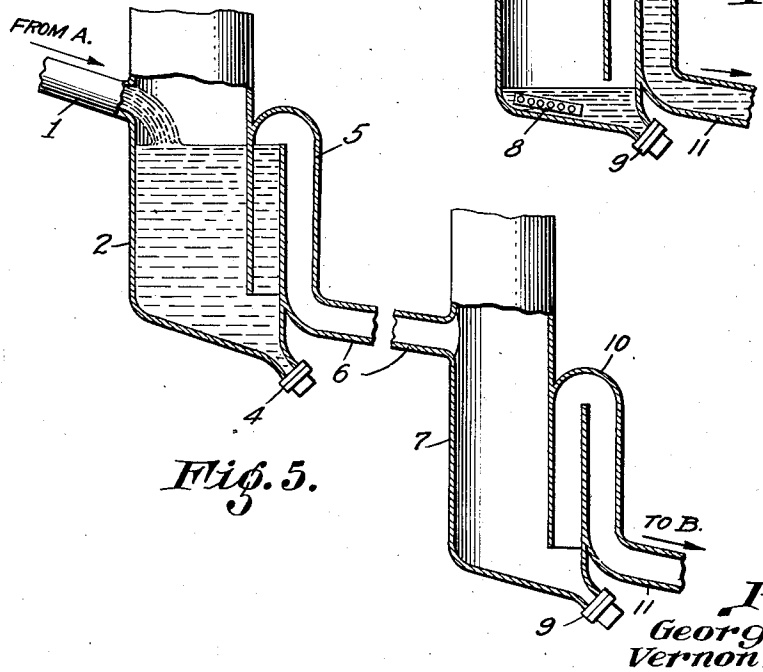


Fig. 5.

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UNITED STATES PATENT OFFICE

2,391,006

TRANSPORT OF AQUEOUS EMULSIONS OF LIQUID EXPLOSIVES

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Original appplication September 2, 1941, Serial No. 409,322. Divided and this application September 19, 1942, Serial No. 459,008. In Great Britain September 2, 1940

3 Claims. (Cl. 23—252)

The present invention relates to an improved apparatus for transferring liquid explosives from one place to another. The invention relates in particular to the transfer of a liquid explosive comprising one or more nitric esters of polyhydric alcohols, e. g. nitroglycerine or a mixture of nitroglycerine with nitroglycol, nitropolyglycerine or nitrated carbohydrates. This application is a divisional of our application Serial No. 409,322, filed September 2, 1941, now Patent No. 2,368,638.

In the manufacture of nitroglycerine and similar liquid nitric esters it is customary to separate the liquid nitric ester from the refuse nitrating acid and then to wash the separated liquid nitric ester by agitating it with water and usually further with a dilute alkaline solution, after which it is removed from the separating house to the final washing house in which it is further washed. For this purpose the partly washed nitric ester is sometimes run to its destination along a line of gutters or pipes. Should a detonation occur in the line in which the liquid nitric ester is flowing or in a building connected thereto, it may be propagated along the liquid nitric ester flowing in the line which may thus communicate a detonation from one building to another. In order to avoid the propagation of a detonation through the liquid nitric ester during its transport, the liquid nitric ester is sometimes transported in the form of an aqueous emulsion in which the liquid nitric ester is dispersed in a continuous aqueous phase. The aqueous emulsions of liquid nitric esters, however, separate easily, and difficulty may be experienced in maintaining the emulsion if it is to be transferred over any considerable distance.

This invention has as an object to devise an apparatus suitable for transporting liquid nitric esters whether emulsified or not from one place to a desired distant place at a lower level whereby the risk of communication of detonation over the whole distance between the two places is reduced. Further objects will appear hereinafter.

We have found that the above objects are achieved if the liquid which comprises the nitric ester is caused to flow under gravity to a reservoir from which it is intermittently syphoned and caused to flow to its destination through at least one further reservoir from which it is intermittently removed by syphoning, the intermittent syphoning operations being so timed that they are never all working simultaneously. More specifically the invention comprises an apparatus for transporting a liquid comprising an explosive nitric ester which apparatus comprises a descending line of ducts having spaced along it a plurality of open vessels each having a syphon outlet.

In putting the invention into effect a plurality of open vessels are conveniently spaced along a transport line each being provided with a syphon outlet, that part of the apparatus following the first vessel being adapted to carry away the liquid at a faster rate than it is delivered to it, and the syphons being timed to operate so that they are never all simultaneously at work.

According to a further feature of the invention particularly applicable to the transport of liquid nitric esters in emulsified form each vessel is provided with stirring means, preferably air stirring means. The open parts of the vessel may be protected so as to prevent foreign bodies from falling into them accidentally.

In the case when only two open vessels are employed, the effective capacity of the second is made or adjusted so that it is not filled to the syphoning level until it receives liquid still in the transport pipe between the two vessels after the first syphon has broken.

It is desirable that the distance over which any column of nitric ester emulsion of substantial thickness can exist at one time should be as small as possible and also that the time for which any continuous column of nitric ester emulsion is at its maximum length should be as short as possible. Accordingly, therefore, when more than two open syphoning vessels are employed it is desirable that the effective capacities of the vessels should be such that the second and succeeding vessels are not filled to syphoning level until they receive liquid still in the transport pipe after the preceding syphon has broken.

The vessels may conveniently be made with sloping bottoms and provided with means whereby liquid at the bottom of each vessel may be drained off after the charge has been transported.

The invention is further illustrated by the following drawings of which Figures 1 to 4 represent diagrammatically a vertical section through an apparatus constructed in accordance with our invention, and designed to carry an emulsion of nitroglycerine in water from a point A to a lower point B which is a distance of about 150 feet. Each of the four figures illustrates the same apparatus but shows different stages in the cycle of carrying the emulsion, while Figure 5 is a vertical section through an apparatus designed to carry unemulsified nitric ester.

Referring to Figure 1, 1 represents the delivery pipe approximately 50 feet long which is adapted to deliver the emulsion of nitroglycerine to the

tank 2 at the rate of 25 litres per minute. The tank is fitted with a perforated pipe 3 into which a stream of air is forced. This stream of air passes out of the tube by the perforations and the stirring action of the rising bubbles of air maintains the emulsion and re-emulsifies any nitroglycerine which may have separated out. The tank 2 is also fitted with a drainage cock 4, to facilitate cleaning. A syphon 5 is arranged to empty the tank 2 whenever it contains 25 litres of the emulsion, without reckoning the volume of the air bubbles as part of the volume of the emulsion. The syphon 5 leads to the pipe 6, and these are adapted to lead emulsion away from the tank 2 at the rate of 100 litres a minute. The pipe 6, which is approximately 50 feet long and will hold approximately 35 litres of nitroglycerine emulsion, leads to tank 7 which, like the tank 2, is fitted with an air stirrer 8, drainage cock 9, and a syphon 10 leading into a pipe 11. Pipe 11 is again approximately fifty feet long and leads to the point B. The syphon 10 is so adjusted that it will not commence to empty the tank 7 before the syphon 5 has broken and preferably not until the pipe 6 is almost empty.

Figure 1 illustrates the first stage in the cycle of operations, the tank 2 has filled almost to syphoning level. The emulsion in the tank is being kept stirred by the streams of bubbles rising from the perforated pipe 3. At this stage the whole of the system is empty from the syphon 5 to the point B.

Figure 2 shows the next stage. The syphon 5 has emptied the tank 2 at the rate of 100 litres per minute. As the tank is filling at the rate of 25 litres per minute approximately 30 litres of nitroglycerine emulsion will have poured into the pipe 6 before the syphon 5 breaks. As the capacity of this pipe is 35 litres the syphon 5 will have broken before any appreciable quantity of emulsion has reached the tank 7. At this stage there are two breaks in the column of emulsion between A and B. Firstly a small but rapidly increasing gap at the syphon 5, and secondly a long gap, which is maintaining its length, in pipe 11.

The next stage is shown in Figure 3. Here the pipe 6 is almost empty but the tank 7 is full to the syphoning point. The tank 2 is about one third full. There is a long gap in the column of emulsion from the syphon 5 nearly to tank 7 and still a gap in pipe 11.

Figure 4 shows the tank 7 empty, the syphon 10 having just broken. The tank 2 is two-thirds full. There is a gap in the column of emulsion from syphon 5 to the foot of tank 7.

When the pipe 11 has emptied, the tank 2 will again be full and the cycle will recommence. Preferably the tank 7 will be of such a size that the syphon 10 will operate with certainty on the 30 gallons which is flowing in each cycle but it is of course possible to vary the size in comparison with the liquid which is carried in each cycle, but the smaller the size of the tank in comparison with the liquid carried in each cycle the shorter will be the break which it maintains in the column of emulsion; on the other hand, if a tank gets too large with respect to the liquid passing in each cycle there is a danger that a syphon will fail to work in one cycle, and will operate when the first emulsion of the next cycle flows into it. This will greatly reduce the length of the break in the emulsion, and, if the capacity of the pipes is small, may destroy it entirely for a time. The possibility of this occurring will be greatly minimised if three or more tanks and syphons are used along the transport pipe instead of two.

Figure 5 illustrates a form of apparatus suitable for the transport of unemulsified liquid nitric ester. Except for the fact that the air stirrers are omitted this is in all respects similar in form and function to the apparatus illustrated in Figure 1 and the numbers refer to the corresponding parts in each case.

This invention is a valuable advance in the art as it provides an apparatus wherewith explosive liquid nitric esters can be run from one building to another without forming a column connecting the houses along which a detonation can propagate, this assists in confining any explosion which may occur during manufacture to one building and therefore contributes to the safety of manufacture.

As many apparently widely different embodiments of this invention may be made without departing from the spirit and scope thereof, it is to be understood that the invention is not limited to any specific embodiment except as defined in the appended claims.

We claim:

1. An apparatus for transporting liquid comprising an explosive nitric ester, which apparatus comprises a plurality of open vessels positioned at descending levels, each vessel containing an inlet and an outlet, siphon means at the outlet of each vessel and conduits connecting the exterior of said siphon means to the inlet of the next vessel, the structure of said conduits, vessels, and outlets being characterized by the fact that the volume of siphon conduits from one vessel is greater than the volume of the effective siphoned height of liquid in that vessel in which the siphoning commences and that the corresponding effective volume of liquid in the vessel into which the conduit empties, nearly approaches the volume of the conduit, and the cross-sectional area of the conduit is such that the first vessel discharges at a greater rate than it fills.

2. An apparatus as claimed in claim 1 in which each vessel is provided with stirring means.

3. An apparatus as claimed in claim 1 in which each vessel is provided with air stirring means.

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