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APPARATUS FOR DISTILLING OFF AND RECOVERING THE SOLVENT USED IN THE MANUFACTURE OF EXPLOSIVES.

APPLICATION FILED MAR. 24, 1906.

904,636. **Patented Nov. 24, 1908.**

3 SHEETS—SHEET 1.

Fig. 1

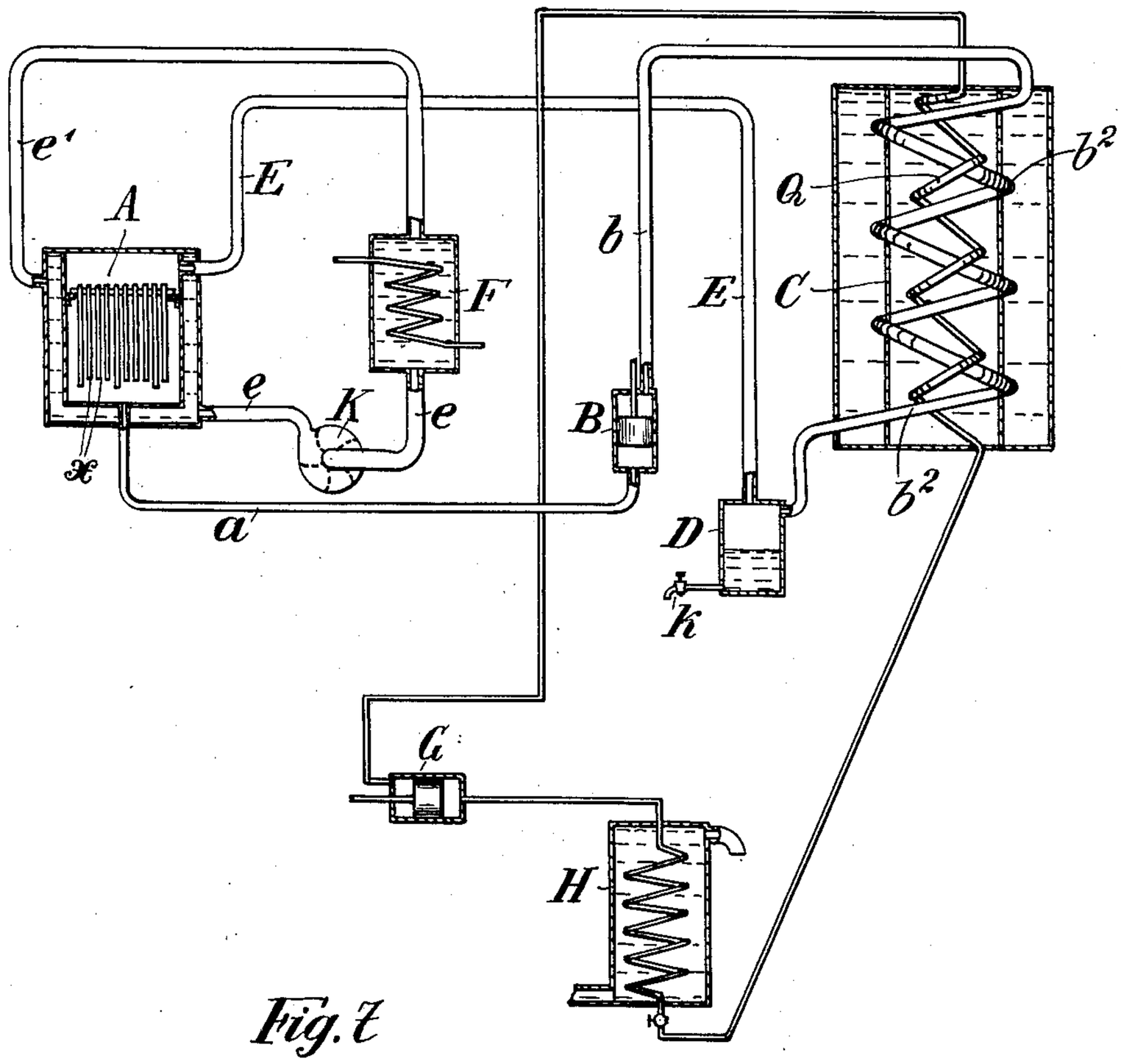
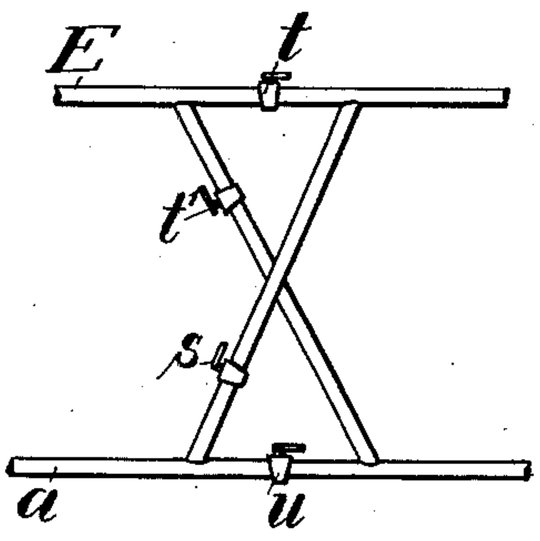


Fig. 2



WITNESSES.

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3 SHEETS—SHEET 2.

Fig. 2

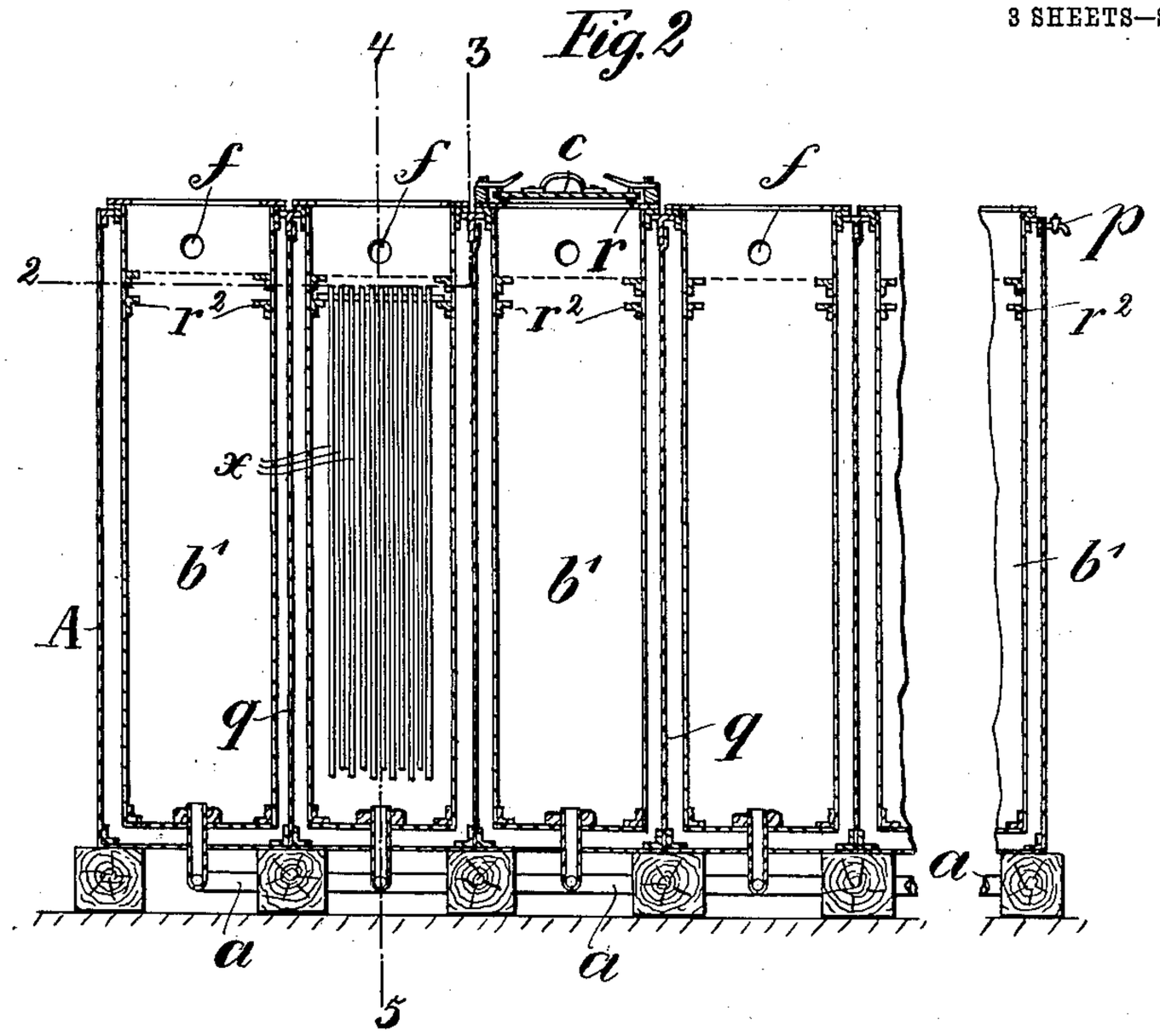
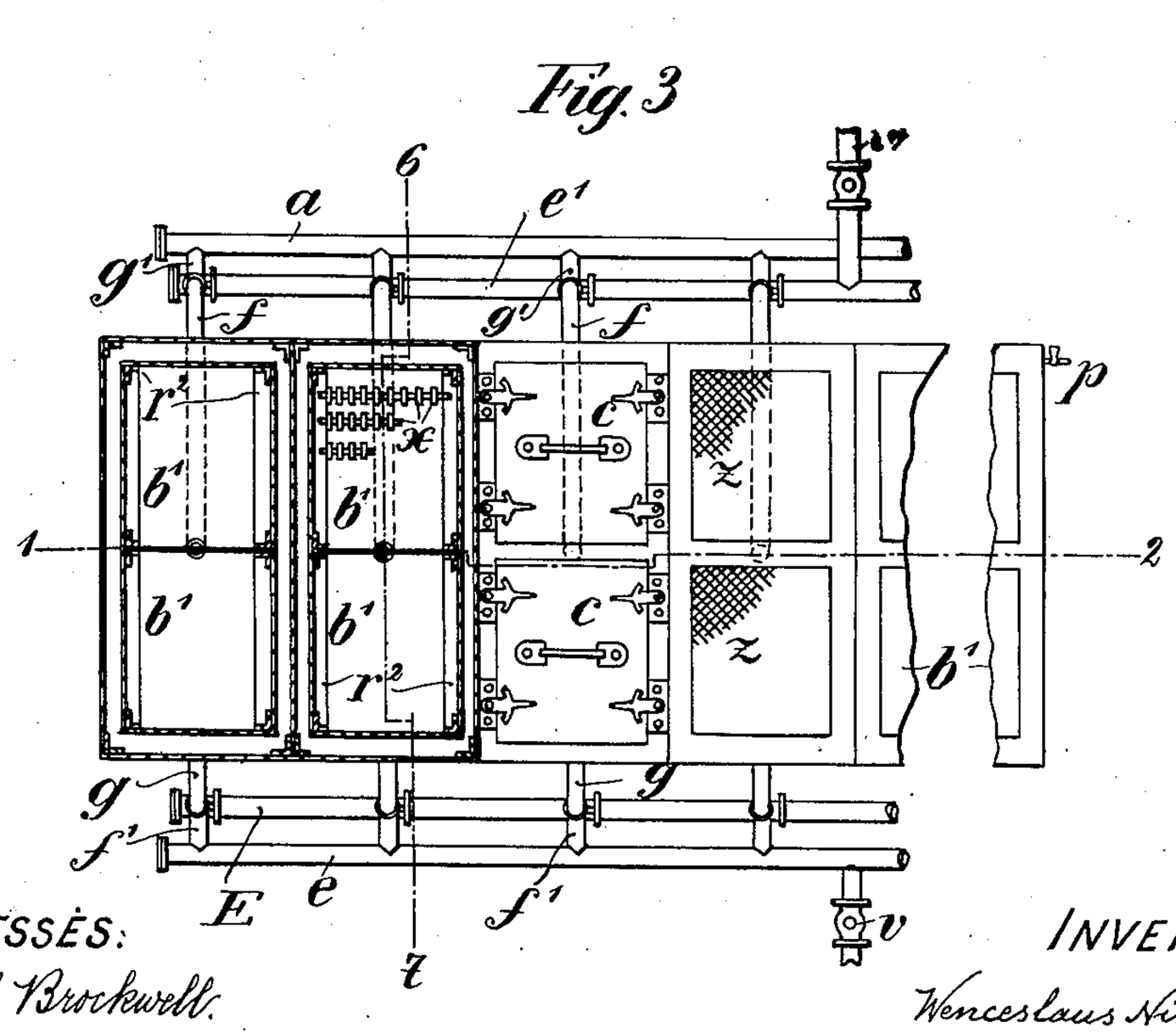


Fig. 3



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3 SHEETS—SHEET 3.

Fig. 4

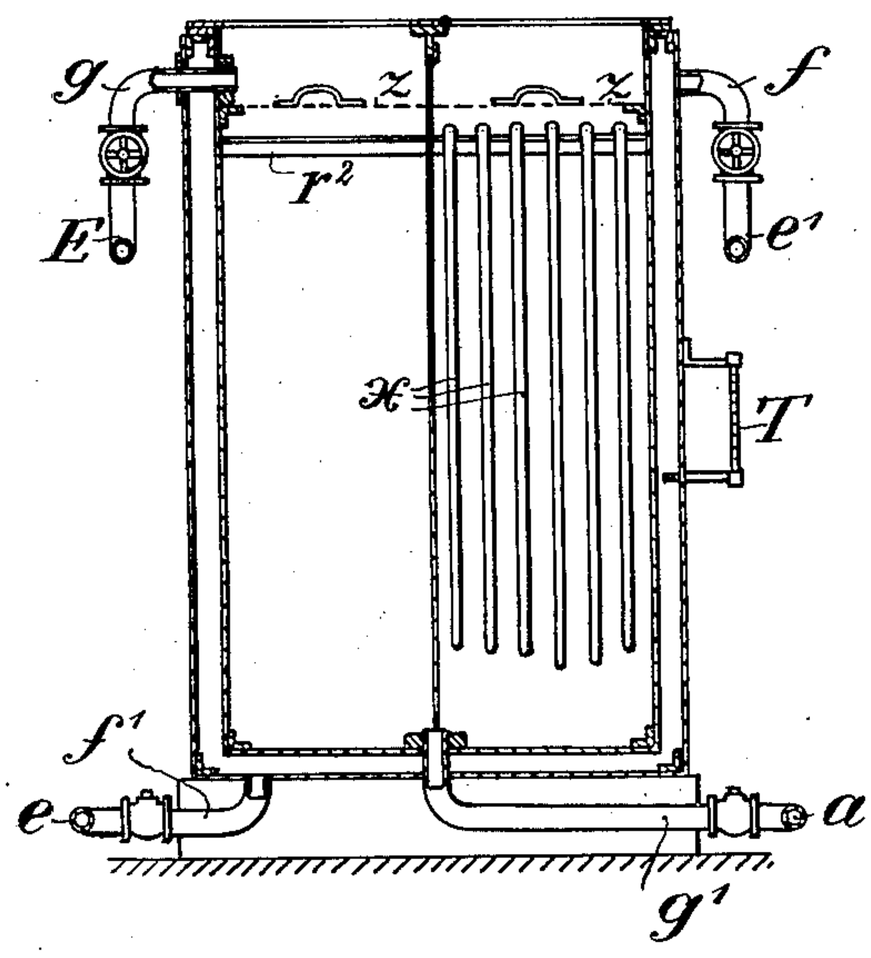


Fig. 5

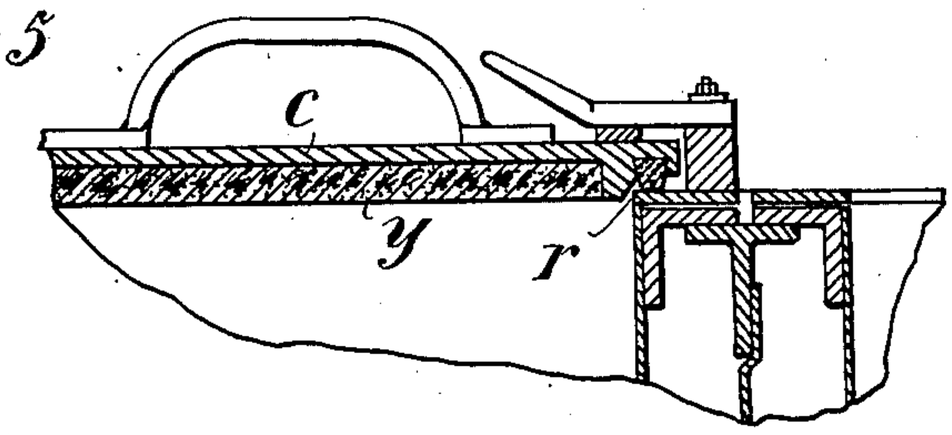
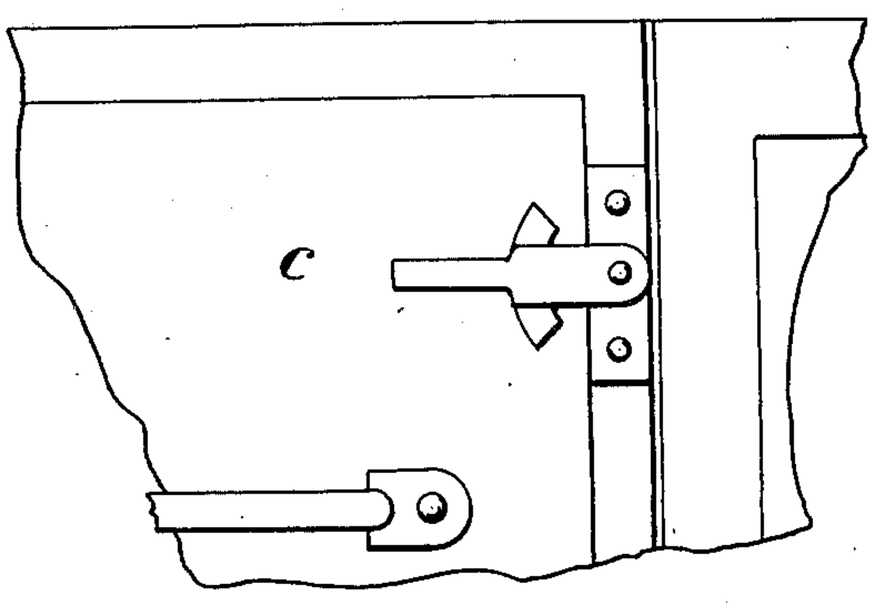


Fig. 6



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UNITED STATES PATENT OFFICE.

WENCESLAUS NIKOLSKY, OF ST. PETERSBURG, RUSSIA.

APPARATUS FOR DISTILLING OFF AND RECOVERING THE SOLVENT USED IN THE MANUFACTURE OF EXPLOSIVES.

No. 904,636. Specification of Letters Patent. Patented Nov. 24, 1908.

Application filed March 24, 1906. Serial No. 307,869.

To all whom it may concern:

Be it known that I, WENCESLAUS NIKOLSKY, a subject of the Czar of Russia, residing at St. Petersburg, Russia, have invented certain new and useful Apparatus for Distilling Off and Recovering the Solvent Used in the Manufacture of Explosives, of which the following is a specification.

The present invention relates primarily to the recovery of the volatile solvents usually employed in the manufacture of smokeless or comparatively smokeless gunpowder, after the explosive material has been pressed into the shape of strings, ropes or cords, but it may be applicable also to the recovery of solvent from other kinds of explosives in the shape of cords, strings or similar bodies.

If the solvent is driven out of the moist powder-cord too rapidly, the latter may be spoiled by the formation of blisters, laminæ, cracks and similar irregularities, and the ballistic properties of the powder would thereby be reduced. Consequently, for obtaining favorable results the solvent must be distilled off very slowly with gradual heating, which may be effected by providing, that during the distillation the cord remains constantly enveloped by the vapors of the solvent in a closed chamber, whose temperature is regulated, and by so arranging the appliances necessary for the purpose, that the solvent vapors which remain uncondensed may immediately return to the place where they are generated. The plant or system of appliances hereinafter described has been designed to meet these requirements.

Figure 1 of the accompanying drawings is a diagram showing the general arrangement of plant for distilling off the solvent according to the present process; Figs. 2 to 7 represent details of construction.

The plant shown in Fig. 1 comprises the following parts:—1. A specially constructed chest A for heating the powder cord x, which is suspended from a rail or otherwise mounted in the chest. 2. An air compressor B serving to draw the solvent vapors out of the chest A through a tube a, and also for delivering them to the cooler C through pipe b. 3. A cooler C consisting of a cylinder filled with calcium chlorid solution and provided with a pipe coil b^2, which is cooled by means of carbonic acid, ammonia or other suitable medium supplied by a refrigerating machine. 4. A receiver D in which the condensed solvent accumulates. 5. A pipe E leading from the receiver to the chest and serving to return to the chest the uncondensed solvent vapors. 6. A heater F for heating the water circulating between the inner and outer wall of the chest, which circulation is produced by means of a centrifugal pump K and the system of pipes e and e^1 connecting the heater with the chest. 7. A refrigerating machine operating by means of carbonic acid and comprising a compressor G, a condenser H serving to liquefy the gaseous carbonic acid by means of the said compressor, and an evaporator Q in the shape of a pipe coil dipping into the calcium chlorid solution, and in which the liquid carbonic acid flowing from the condenser through a fine opening is converted partly into the solid and partly into the gaseous condition, thereby cooling the walls of the cooler and consequently also the said solution, as well as the pipe coil b^2 dipping into the latter. From the evaporator the carbonic acid flows again into the compressor, by which it subsequently is liquefied in the condenser.

Fig. 2 is a vertical section of the chest A along line 1—2 of Fig. 3. Fig. 3 is a plan of the chest, partly in section, the two left hand compartments being shown in horizontal section along line 2—3 of Fig. 2. Fig. 4 is a cross section of the chest along lines 4—5 and 6—7 of Figs. 2 and 3. Fig. 5 is a partial longitudinal section through a cover for the compartments of the chest and through the adjacent parts of the chest, on a larger scale. Fig. 6 is a plan of the parts shown in Fig. 5. Fig. 7 shows a detail of construction, as will be hereafter explained.

A chest A is composed of a large metallic casing provided with partitions q, which divide it into several equal divisions b^1, b^1, capable of being hermetically closed by the lids c with india-rubber packing r.

In Figs. 2 and 3 the third division only (counted from the left hand side) is shown covered with two lids (with flat or butt joints), while the other divisions are shown without lids, for the sake of simplicity.

The various divisions or compartments have double walls, between which circulates the water serving to heat the interior of the compartments. Each of the compartments communicates with pipes f, f^1 and g, g^1 (Figs. 3 and 4), the pipes f, f^1 extending

only through the outer walls of the chest and serving for the circulation of the water, while the pipes g, g^1 pass through the walls of the chest and serve to draw off the solvent vapors and to return to the chest the vapors which have passed uncondensed through the cooler. Each of the said tubes has a cock or valve, so that in each division the temperature of the water, as well as the quantity of the solvent vapors to be drawn off and returned, may be regulated at will, which is an important requirement for the manufacture of powder cords free from blisters or layers of air.

The corresponding pipes of the different divisions of the chest are connected with the same common or omnibus tubes, of which there are four, viz: e, e^1 and a E (Figs. 1 and 3), placed along the chest. The tubes e and e^1 forming part of the closed system or circuit composed of the chest, the heater and the centrifugal pump serve for the circulation of the heated water, while the tubes a and E form part of another closed circuit, which includes the chest, the air compressor and the cooling pipe, one of the tubes serving to draw off the solvent vapors arising in the chest, and the other serving to return the vapors which have passed uncondensed through the cooler. It will be observed, that the pipes for conducting the vapors and the valves are so arranged, that the vapors may be drawn off either at the bottom or at the top of the chest. In the former case the return should of course take place at the top and in the latter case at the bottom. Such a change in the direction of the circulation of the solvent vapors may promote the uniform drying of the powder cord in the chest.

As indicated by the diagram Fig. 7, the tubes a and E are connected with each other by inclined tubes crossing each other and provided with cocks t^1 and s. If these cocks are closed, while the cocks t and u situated in the tubes a and E between the cross-tubes, remain open, the solvent vapors are pumped through the lower tube a and return through the tube E. On the other hand, if the cocks u and t are closed, while the cocks t^1 and s are open, the direction, in which the vapors move, is changed.

In order to cool the chest (which is especially necessary, when the chest has received a fresh charge of thick powder cord), the warm water is discharged from the same through the ordinary let-off cock v, Fig. 3, connected with the above mentioned tube e extending along the lower part of the chest. At the same time water is supplied to the chest through the tube w, Fig. 3, coming from a water conduit and connected with the water pipe e^1 extending along the upper part of the chest, until the chest contains sufficient water for attaining the desired temperature in the chest.

By regulating the supply of water by means of the cocks of the water-pipes f, f^1 the desired temperature may be established separately in each division of the chest. Thermometers T (Fig. 4) are provided for observing the temperature in the individual divisions. For drawing the air out of the chest, while being filled with water, a cock p (Figs. 2 and 3) is provided in the extreme right hand division of the chest. To allow the air from the other divisions to escape through the same cock, their partitions q (Fig. 2) have fine openings in their upper part (not shown).

The charging of the divisions of the chest takes place one after another, each division being hermetically closed by its lid immediately after it has been charged. Before the charging the powder cord x is suspended from a rail or bar, which is then laid with its free ends upon the angle-irons r^2, r^2 (Figs. 2, 3 and 4) fixed to the inside of the divisions b^1 near the top of the same.

For more uniformly distributing the cold vapors which are not condensed in the cooler and pass into the upper parts of the chest, which is desirable for the uniform drying of the powder cords, a metal plate Z (Figs. 3 and 4) with fine perforations is mounted above the powder cords and below the mouth of the gas pipe g.

To avoid waste of heat, the chests are enveloped in a bad conductor of heat and an outer casing of wooden boards, which have been omitted from the drawing for the sake of simplicity. The covers of the individual divisions or compartments are lined inside with a layer of cork y (Fig. 5).

The air compressor B (Fig. 1) may be of any ordinary construction and serves chiefly for drawing off the solvent vapors arising in the compartments of the chest and for introducing the same into the pipe coil of the cooler. The vapors which pass uncondensed through the cooler, are returned to the chest by the action of the same compressor.

The cooler C (Fig. 1) consists of an iron cylinder with double walls, between which is located a pipe coil b^2 serving to cool the solvent vapors. The interior of the cylinder contains a whole series of pipe coils Q, which receive from the condenser H (Fig. 1) of the refrigerating machine the liquid carbonic acid admitted through the small openings of the cocks inserted into the pipe coil Q, a portion of which carbonic acid immediately congeals to snow, while another portion evaporates and thereby effects an energetic cooling of the walls of the pipe coils.

The gaseous carbonic acid is drawn through the passages of the upper cocks (not shown) of the pipe coils Q by the compressor of the refrigerating machine and again liquefied by the same in the cooler H belonging to the said machine.

The medium used for transmitting the cold from the pipe coils containing carbonic acid to the pipe coil for the solvent vapors is preferably a solution of calcium chlorid, which fills the cylinder of the cooler and also the space between the walls of the same.

The receiver D (Fig. 1) is simply a closed iron cylinder provided with a liquid gage of glass (not shown in the drawing) and with a cock *k* serving to draw off the liquid solvent. The lower end of the pipe coil b^2 of the cooler communicates with the upper part of the receiver D, so that the solvent condensed in the coil will flow off into the receiver, while the uncondensed vapors return to the chest A through the pipe E joined to the cover of the receiver D.

The heater F (Fig. 1) is a closed cylinder provided in its interior with a pipe coil and filled with water, which is heated by means of the hot steam circulating through the coil. The water fills not only the heater itself, but also the jacket of the chest A connected with the heater by pipe conduits *e*, e^1 and the centrifugal pump K. The latter serves chiefly to establish and maintain the circulation of the hot water.

The refrigerating machine acting by means of carbonic acid differs from similar machines hitherto used only by the arrangement of the above described evaporator (of the cooler C) which is adapted for the condensation of the vapors of the solvent, at the time when it is distilled off from the powder cord.

As indicated above, the refrigerating machine chiefly comprises the compressor G serving to convert the gaseous carbonic acid into a liquid, the condenser H, in whose pipe coils the carbonic acid is liquefied by the effect of the compressor and the cooling water which envelops the said pipe coils; and the above described evaporator (of the cooler) from which the gaseous carbonic acid reënters the compressor, thence again into the condenser and so on.

What I claim is:—

In apparatus for distilling off the solvent from freshly prepared cords of relatively smokeless explosives, the combination of a jacketed chest for holding the powder cords to be relieved of solvent, with a heating appliance communicating through pipes with the jacket of the said chest and adapted to heat the same, a pump adapted to draw solvent vapors out of the said chest, a cooler connected with the said pump and adapted to condense the solvent vapors drawn off by the pump, a refrigerating machine having an evaporator connected with the said cooler, and a receiver adapted to receive and discharge the solvent condensed in the cooler, the upper part of the said receiver communicating with the said chest, so as to allow the uncondensed vapors to return to the chest, substantially as described.

In testimony whereof I have set my hand hereunto in the presence of two subscribing witnesses.

WENCESLAUS NIKOLSKY.

Witnesses:
H. A. Loviaguine,
Edwd. Wauscheidt.