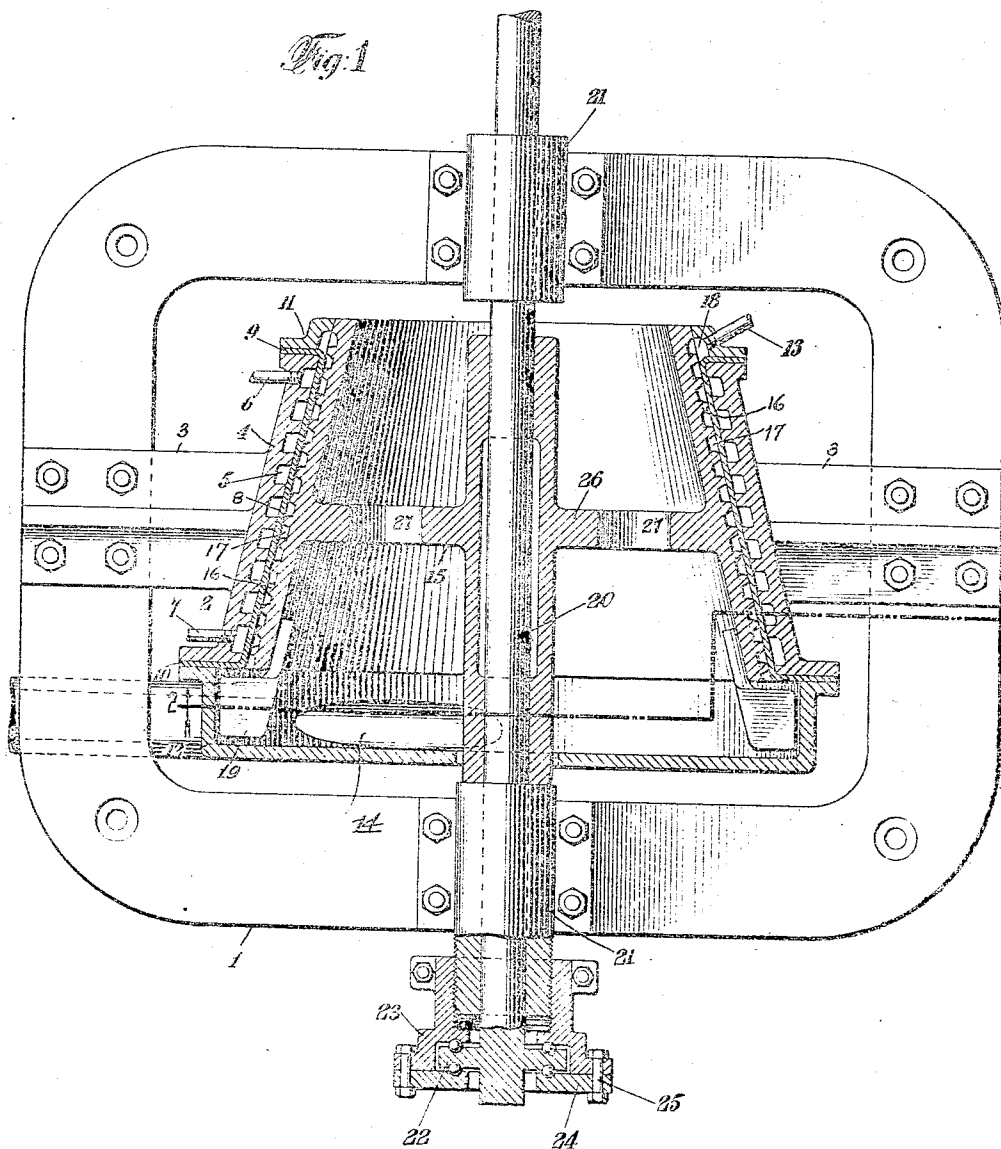


F. I. DU PONT.
 APPARATUS FOR SOLIDIFICATION OR EVAPORATION.
 APPLICATION FILED SEPT. 16, 1913.

1,284,074.

Patented Nov. 5, 1918.

2 SHEETS—SHEET 1.



Witnesses:
L. Rudwick
J. Freudenwall

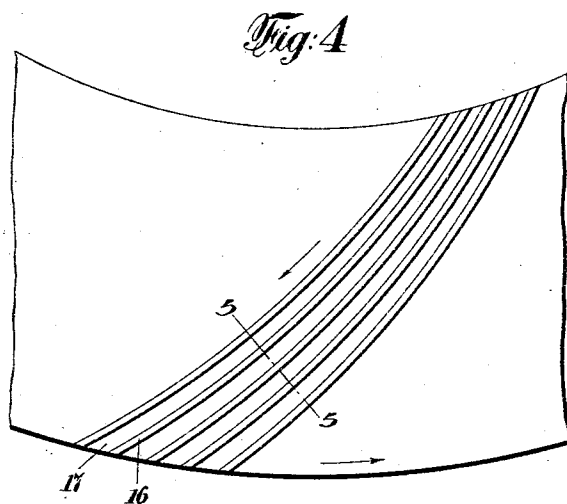
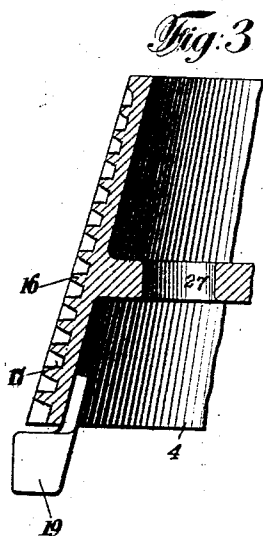
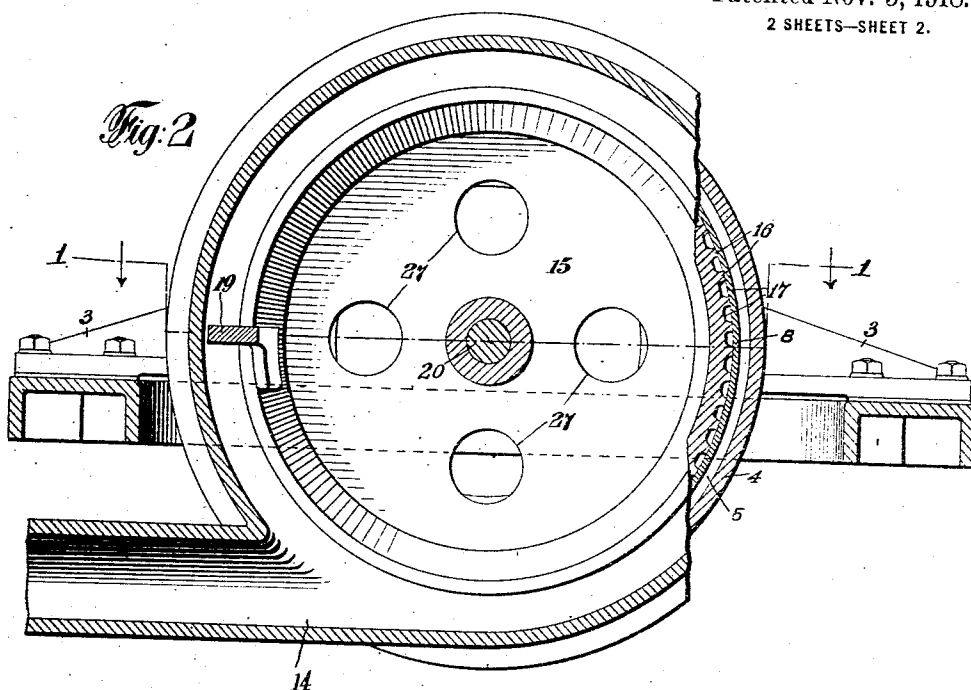
Inventor
Francis I. DuPont
 By his Attorneys
Binckley & Wright

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Witnesses:
 L. Braderick
 J. Freudenwall

Inventor
 Francis I. du Pont
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UNITED STATES PATENT OFFICE.

FRANCIS I. DU PONT, OF WILMINGTON, DELAWARE, ASSIGNOR, BY MESNE ASSIGNMENTS, TO E. I. DU PONT DE NEMOURS AND COMPANY, A CORPORATION OF DELAWARE.

APPARATUS FOR SOLIDIFICATION OR EVAPORATION.

1,284,074.

Specification of Letters Patent.

Patented Nov. 5, 1918.

Application filed September 16, 1913. Serial No. 790,055.

To all whom it may concern:

Be it known that I, FRANCIS I. DU PONT, of Wilmington, in the county of New Castle, and in the State of Delaware, have invented
5 a certain new and useful Improvement in Apparatus for Solidification or Evaporation, and do hereby declare that the following is a full, clear, and exact description thereof.

10 My invention relates to a process for solidification or evaporation of materials of many different kinds and to an apparatus used in connection therewith. While my invention is capable of application to the
15 solidification or evaporation of many different materials and in many different arts, it is especially useful in connection with the evaporation of explosives.

The object of my invention is to provide
20 a process and apparatus for evaporation in the manner above indicated, which may be used to carry out a rapid evaporation of the materials treated and which is exceedingly simple both as to the process involved and
25 as to the apparatus used. My invention is such also that the evaporation may be carried out continuously and without any danger of interruption due to failure of the process and apparatus to work in the manner intended. My invention is applicable especially, as indicated above, to the evaporation of explosives; and in this connection it is applicable not only to the evaporation of liquids containing undissolved solids, but
35 also to the evaporation of explosives entirely dissolved in a liquid or liquids. In the latter connection it is especially applicable to the evaporation of solutions of water soluble explosives.

40 For the purpose of illustration, the process and apparatus may be used in connection with the evaporation of explosive mixtures or solutions made in the following manner.

45 As one example of such a mixture I may use a composition comprising 73% of nitrate of soda, 11% of sulfur and 16% of charcoal. These ingredients are mixed with an equal weight of water.

50 As another example, I may apply my invention to the evaporation of a water soluble explosive mixture comprising an oxygen carrier such as one of the nitrates of sodium, potassium and ammonium, or a chlorate,
55 such for example as potassium chlorate,

and an organic material such as one of the sodium or potassium salts of the sulfonic acids of various hydrocarbons, such for instance as sodium benzol sulfonate or sodium cresol-sulfonate. These ingredients may be
60 dissolved in any desired proportions in a body of water so as to produce when evaporated an explosive composition having the desired characteristics.

In order to evaporate one of the materials above referred to in accordance with
65 my invention, as for example, one of the explosive mixtures or solutions above referred to, I may make use of many different types of apparatus made in accordance with
70 my invention. For the purpose of illustration, however, I have shown one form of apparatus in the accompanying drawings, in which—

Figure 1 is a plan view partly in section
75 of an apparatus made in accordance with my invention,

Fig. 2 is a transverse vertical section through a portion thereof, on line 2—2,

Fig. 3 is an enlargement of a detail
80 therein,

Fig. 4 is a development of the outer surface of the cone carrying the grooves appearing in the preceding figures, and

Fig. 5 is a cross-section of a detail of
85 said cone.

In the drawings I have indicated an apparatus in which I may use a main frame 1 having a central opening 2. The main frame 1 may be provided with a plurality
90 of inwardly projecting arms or supports 3 carrying a frusto-conical shell 4. The inner surface of the shell 4 is provided with a circuitous passageway 5 to receive a current of steam or other heat transferring
95 medium which is fed to the same through an inlet 6 and exhausted from the same by means of an outlet 7. The circuitous passageway 5 is covered by a conical shell 8 of
100 any desired material but preferably of copper which serves the purpose primarily of providing upon its interior a surface for solidifying or evaporation and also as a means for confining the heat transferring
105 medium within the circuitous passageway 5. The shell 8, as will be seen hereinafter, forms the wall separating the heat transferring medium from the material to be solidified or evaporated. As indicated in the accompanying drawings, the ends of the
110

shell 8 may be formed into plane surfaces to produce flanges 9 and 10 at the two ends of the shell, said ends being then retained in place by superimposing upon the same respectively end closures 11 and 12. The end closure 11 may be provided with an inlet opening 13 to receive the material to be evaporated while the end closure 12 may be provided with an outlet opening 14. Within the interior of the shell 8 I provide a frusto-conical drum 15 which has a plurality of spirally arranged ridges 16 to form between the same a plurality of similarly located grooves 17. As will be seen by reference to Fig. 3, the grooves 17 are closed at the small end of the drum while they remain open at the large end of the drum. The drum is furthermore so arranged that the tops of the ridges 16 lie closely adjacent to the inner surface of the shell 8 and the grooves 17 at the smaller end of the drum connect with an annular passageway 18 situated in the end closure 11 and communicating with the inlet opening 13. The grooves 17 are preferably made deeper and wider at the larger end of the drum 15 in order that, in the evaporation of liquids from the material being treated, the larger amounts of gases or vapors present at the outlet ends of the grooves 17 may be properly accommodated. The solidified materials which pass out from the larger ends of grooves 17 are thrown by centrifugal force into the large end closure 12 and are there rotated by means of vanes 19 attached to the interior of the drum 15, around the inner periphery of the end closure 12 until they are discharged from the outlet opening 14. The drum 15 is supported upon and rotated by means of a shaft 20 carried in journals 21 situated upon the main frame. One end of the shaft 20 is arranged with a thrust bearing comprising an annular flange 22 supported between two sets of ball bearings located respectively on opposite sides thereof and carried in an outer shell formed by a sleeve 23 and a plate 24 covering the same. The sleeve 23 is screw-threaded upon an extension of the bearing 21 at the large end of the drum and the sleeve 23 and the plate 24 may be secured together by means of bolts 25. By changing the position of the sleeve 23 upon the bearing extension the position of the drum 15 may be changed when desired. It will also be seen by reference to Fig. 1 that the interior of the drum 15 comprises a transverse plate 26 which has a plurality of apertures 27 to permit the passage of air and thus maintain the drum at a slightly different temperature from the outer shell.

In carrying out my process, as for example, in connection with the use of the apparatus above described, I may proceed as follows: Assuming that it is desired to

evaporate a solution of an explosive, a composition such as that referred to above and being dissolved in water is led into the evaporating apparatus through the inlet opening 13. From this point, the composition to be evaporated is fed through the annular passageway 18 to the spiral grooves 17. The apparatus has been previously heated and is maintained at the proper temperature by means of a current of steam entering the inlet passageway 6 and leaving by means of the outlet 7. The current of steam which is thus passing through the circuitous passageways 5 maintains the evaporating surface upon the inner face of the shell 8 at the desired temperature. As the liquid passes through the grooves 17 in the drum 15, which is rotating at the desired speed, it is thrown by centrifugal force into contact with the shell 8, the temperature of which is such as to evaporate the liquid contained in the composition. The evaporation of the liquid results in the deposition of the solids upon the inner face of the shell 8 which solids are continually removed therefrom by the ridges 16 owing to the rotation of the drum. The solid materials thus formed are conveyed toward the larger end of the drum 15 under the centrifugal action in the grooves 17 until they are discharged from the grooves 17 and reach the interior of the end closure 12 in which they are carried around centrifugally by the vanes 19 until they are discharged through the outlet passageway 14. The steam which is formed within the grooves 17 is also conducted toward the larger end of the drum 15, the grooves being larger at the larger end of the drum to accommodate the increasing quantity of steam as it passes outwardly in this direction. The steam thus formed escapes from the apparatus either through the outlet 14 or axially through the center of the end closure 12, or it may be conducted away in any other suitable manner. The apertures 27 in the plate 26 are preferably provided so as to maintain the temperature of the grooves 17 in the drum 15 slightly lower than the temperature of the shell 8 so that thereby the grooves 17 are maintained somewhat moist so long as there is any liquid not yet evaporated, so that thereby the deposition of solids within the grooves 17 is avoided. By adjustment of the thrust bearing carried upon the end of the shaft 20, the drum 15 may be adjusted longitudinally within the shell 8 whenever desired so as to adjust the distance between the ridges 16 and the shell 8, and so as to take up said distance owing to any wear of the parts.

As pointed out above, my invention is capable of application to many different arts and in many different ways. For example, it is not necessarily limited to evaporation but may be applied also to solidifi-

5 cation by the use of cooling mediums. It is
also not necessarily limited to evaporation
to produce solidification, but may be also
applied advantageously to evaporation for
the purpose of concentration. It will be
realized that the principles of operation in-
volved make the apparatus useful for adap-
tation to many different and widely sepa-
rated arts. It will be also understood that
many changes may be made in the details
of the invention as set forth above without
departing from the spirit of my invention.

I claim:

1. In combination, a pair of relatively ro-
tatable telescoping drums having adjacent
compartments, one of said compartments
containing a temperature changing medium
and the other material to be treated, and a
centrifugal discharge device associated with
said drums.

2. In combination, a pair of relatively ro-
tatable telescoping drums, one of said drums
having recesses adjacent the other drum
adapted to contain material to be treated, a
discharge compartment located at one end
of said drums, and means associated with
said drums to discharge the treated material
centrifugally from said compartment.

3. In combination, a pair of relatively ro-
tatable telescoping drums, one of said drums
having recesses adjacent the other drum
adapted to contain material to be treated, a
discharge compartment located at one end

of said drums, and vanes mounted upon one
of said drums to discharge a treated mate-
rial centrifugally from said compartment.

4. In combination, a pair of relatively ro-
tatable drums, one of said drums having
a compartment containing a temperature
changing medium and the other drum hav-
ing spiral grooves containing material to be
treated, said grooves increasing in depth to-
ward the discharge end of said drum.

5. In combination, a pair of relatively ro-
tatable frusto-conical drums, one of said
drums having a compartment containing a
temperature changing medium and the other
drum having spiral grooves containing ma-
terial to be treated, said grooves increasing
in depth toward the larger end of said drum.

6. In combination, two telescoping conical
solidifying drums, the inner drum hav-
ing a spiral groove for feeding the material
to be solidified, the outer drum having a
spiral groove to feed a solidifying agent, a
thin wall separating the diaphragms, and
discharge outlets for the solidified material
and the solidifying agent at the larger end
of the cone.

In testimony that I claim the foregoing I
have hereunto set my hand.

FRANCIS I. DU PONT.

Witnesses:

J. HOWARD GORDON,
P. E. STRICKLAND.

Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents,
Washington, D. C."