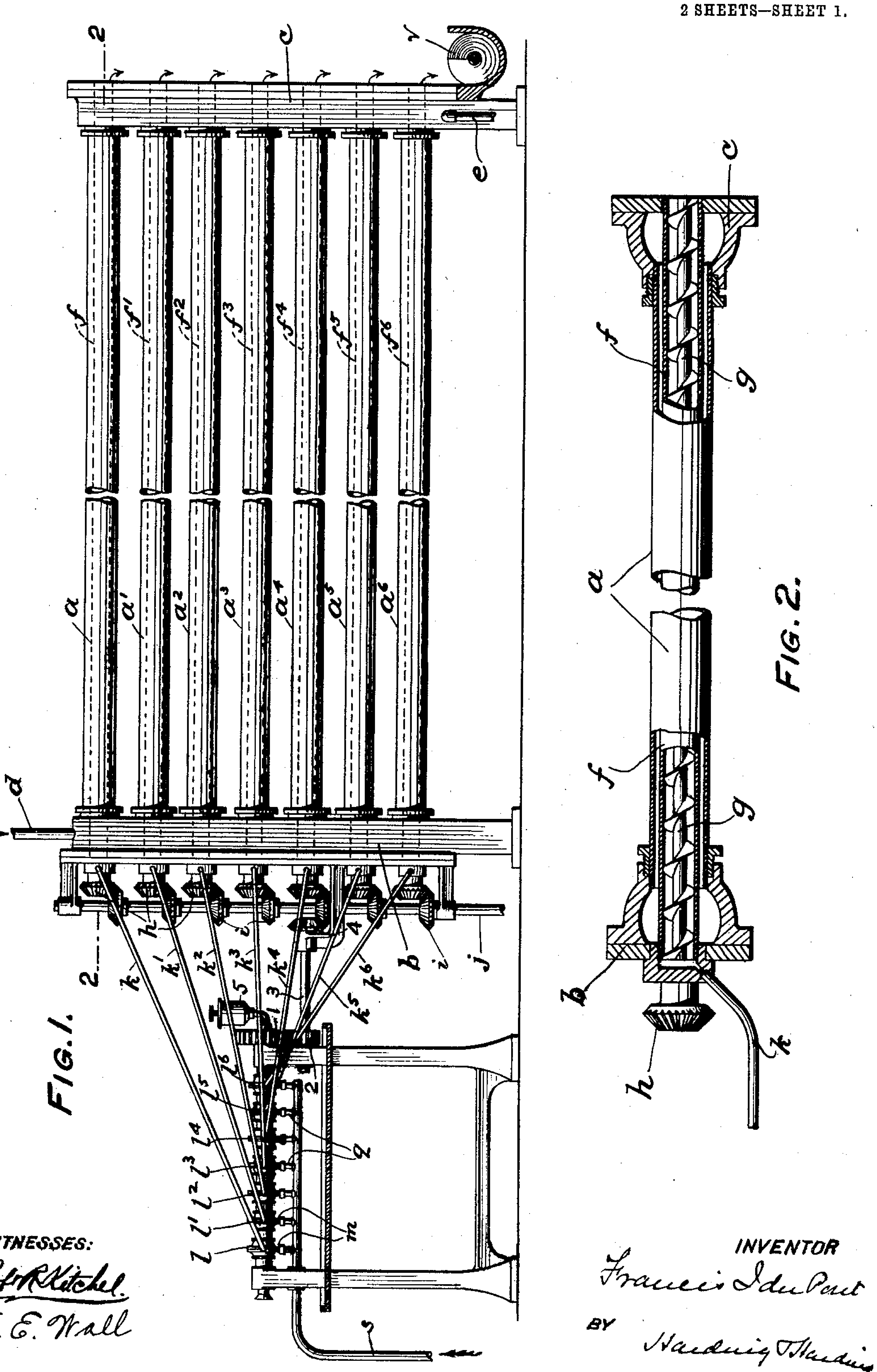
F. I. DU PONT.

METHOD OF EVAPORATING EXPLOSIVE MIXTURES.

APPLICATION FILED NOV. 18, 1908.

944,500. Patented Dec. 28, 1909.

2 SHEETS—SHEET 1.



WITNESSES:

Robt R. Kitchel

E. E. Wall

INVENTOR

Francis I. du Pont

BY Harding & Harding

ATTORNEYS

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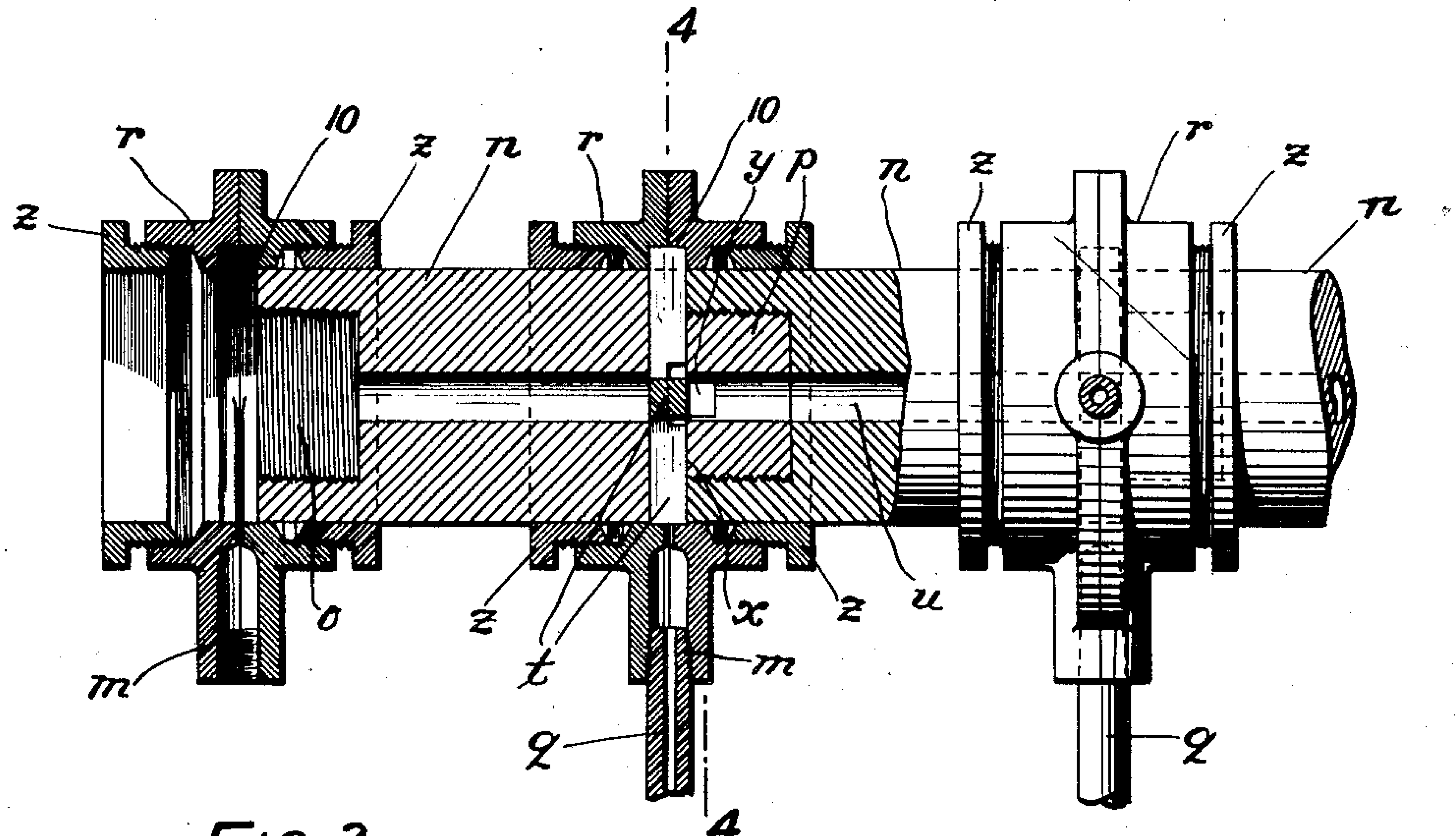

FIG. 3.

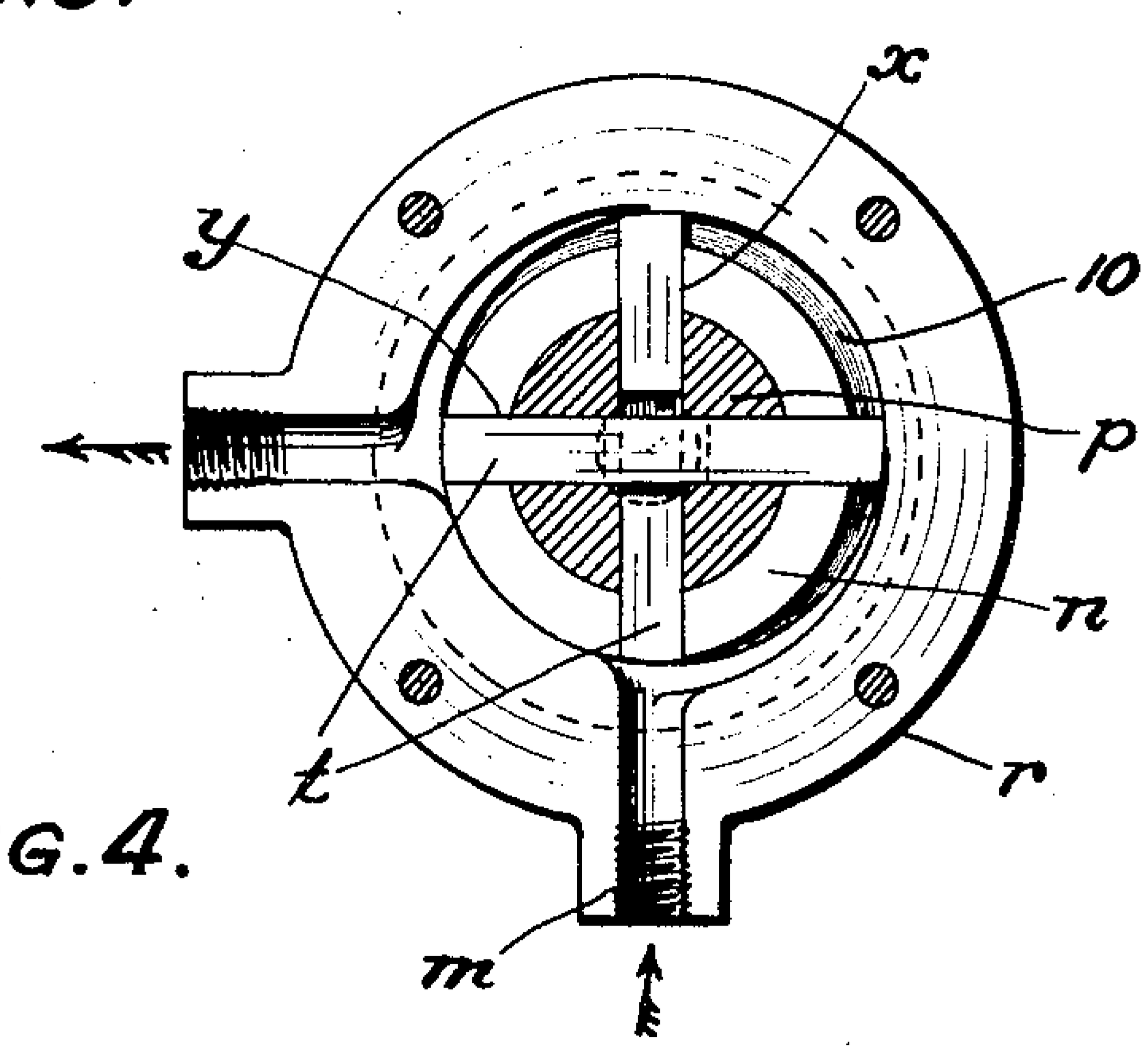

FIG. 4.

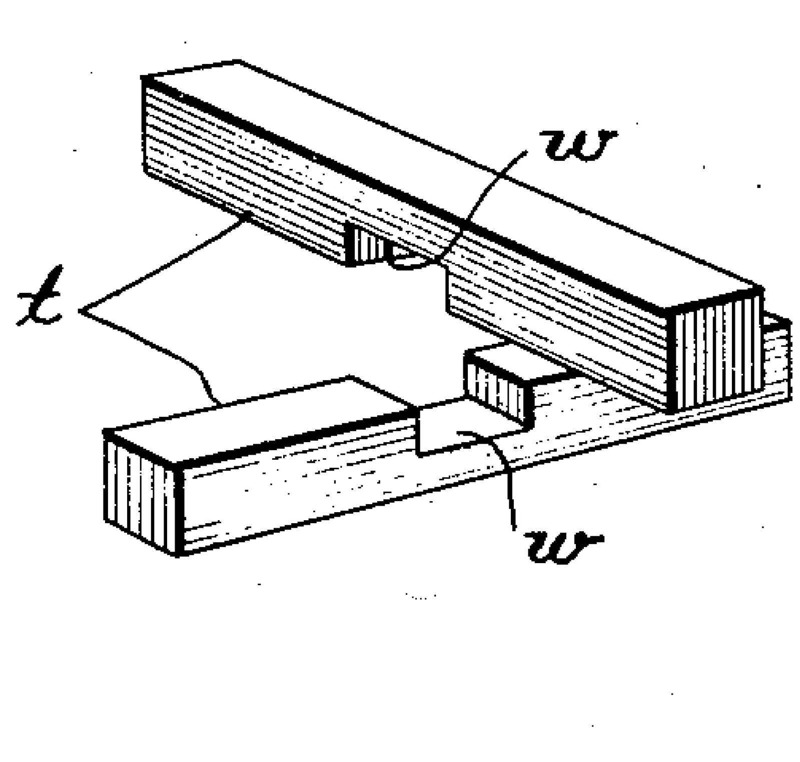

FIG. 5.

WITNESSES:

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E. E. Wall

INVENTOR

Francis I. du Pont

BY

Harding & Harding

ATTORNEYS.

UNITED STATES PATENT OFFICE.

FRANCIS I. DU PONT, OF WILMINGTON, DELAWARE, ASSIGNOR TO THE E. I. DU PONT DE NEMOURS POWDER COMPANY, OF WILMINGTON, DELAWARE, A CORPORATION OF NEW JERSEY.

METHOD OF EVAPORATING EXPLOSIVE MIXTURES.

944,500. Specification of Letters Patent. **Patented Dec. 28, 1909.**

Application filed November 18, 1908. Serial No. 463,248.

To all whom it may concern:

Be it known that I, Francis I. du Pont, a citizen of the United States, residing at Wilmington, county of Newcastle, and State of Delaware, have invented a new and useful Improvement in Methods of Evaporating Explosive Mixtures, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings, which form a part of this specification.

My invention has for its object to provide a method whereby, in an evaporating apparatus for explosive mixtures in which the material is carried by a conveying screw through a tube surrounded by a heating medium, all the material will be brought in contact with the wall of the tube, and thus treated alike with respect to heating and also will be subjected in transit through the tube to a like rubbing by the blades against the wall of the tube. Speaking generally, I accomplish this by subjecting the material in the tube to the action of centrifugal force by rotating the screw conveyer so rapidly that the centrifugal force produced will force any material, attaching or tending to attach to the blades, to the inner wall of the tube.

The apparatus, in which I have carried out my process, in general, comprises a plurality of tubes in each of which is a conveying screw, the blades of which approach closely to the inner periphery of the tube. Surrounding each of these tubes is a tube having a header at each end. To one header is connected a passage for heat supply, say steam or hot air, and to the other header is connected an outlet. To the interior of each of the conveyer tubes is connected a passage from a pump section or a section of a multiple pump. Each of the screw conveyers has at one end, a gear which meshes with a gear upon a vertical shaft. The screw conveyers are revolved at such a high rate of speed that the centrifugal force produced is such as to throw off any solid particles of the explosive mixture, tending to attach to the blades, to the inner periphery of the tube. A passage, in which the explosive mixture passes from the mixing or compounding apparatus, has an independent connection to each pump section and each pump section feeds to a separate evaporating tube. By this arrangement the explosive mixture is divided evenly and properly between the tubes and all the solid particles are forced and held against the heated periphery while passing through the tube and, in their passage through the tubes are worked by the conveyer. Thus all portions of the mixture are subjected to like heat and are held away from the central moisture of the tube and are equally and in like manner worked during said passage.

I will now describe in detail the apparatus illustrated in the accompanying drawings.

In the drawings: Figure 1 is an elevation of the apparatus embodying my invention. Fig. 2 is a detail sectional view on line 2—2 Fig. 1. Fig. 3 is a detail view of a portion of the pump partially broken away. Fig. 4 is a cross section on line 4—4, Fig. 3. Fig. 5 is a perspective view of a pair of pump blades.

a to a^6 are tubes having at one end the header b and at the other end the header c. The header b has the inlet pipe d leading from a heat supply, steam or hot air. The header c has the outlet pipe e. Within each tube a to a^6 is a tube, these tubes being respectively lettered f to f^6. Within each tube f to f^6 is a conveyer g the blades of which rotate closely to the inner periphery of the tubes f to f^6. Each conveyer shaft has connected with it a gear h which meshes with a gear i on the vertical shaft j. This shaft j is rotated, by means not shown, at a high rate of speed. Each tube f to f^6 has a conduit or pipe entering therein, these being lettered k to k^6. These pipes k to k^6 lead from the respective tubes f to f^6 to respective sections l to l^6 of a multiple pump. Each section of the multiple pump has an inlet m, said inlets connecting by pipes q with a conduit s, common to all, leading from the explosive mixer or compounder. Each pump section is formed of a shaft n having the central bore u and formed at one end with the female threaded portion o and at the other end with the male threaded portion p. Surrounding each shaft section is a casing r, made in sections to slip over the shaft, provided with a circumferential but eccentric bore 10 with respect to the shaft.

t are the blades of each pump section (shown in detail Fig. 5) provided with a central cut away portion w. The shaft has two orifices x and y cut therein to allow the insertion of the blades t. The blades t make a loose fit in the orifices in the shaft to allow a sliding movement to follow the eccentricity of the bore 10. One orifice, as shown, y, is made sufficiently larger than the other to allow the insertion of one blade when the other blade t is in position. The inlet m is placed at one end of the eccentric portion and the outlet at the other end.

The material fed into the pump enters the cavity formed by the eccentricity and is carried by the rotating blades to the outlet, the blades following the eccentricity by reason of the movement with respect to the shaft before described and the loose interlocking of the cut away portions of the blades with each other.

It may readily be seen how the pump sections are assembled. Each shaft section being provided with a male and female screw, may be connected to each other, the casing slipped on and glands z inserted to insure tight bearings for the shaft sections, said casings are supported upon the shaft sections and held from rotation by the pipes q.

One end of the shaft n has mounted upon it the gear 1 which meshes with the gear 2 on the shaft 3. At the other end of the shaft is the gear 4 meshing with a gear on the vertical shaft j. Thus the pump is driven from the same shaft which drives the conveyer screws. The central bore u communicates with the oiler 5, thus enabling all the sections of the pump to be oiled from a single point.

In practice I have used conveyer tubes of a diameter of 3¼ inches with the pitch of the conveyer screw of 2 inches and the length of such tubes 23 feet. The conveyers should rotate at least 288 revolutions, and not below 250 revolutions per minute. I prefer to rotate them at 300 revolutions per minute. I have used an explosive mixture comprising 73 per cent. nitrate of soda, 11 per cent. sulfur and 16 per cent. charcoal. These ingredients are mixed, before the evaporation, with equal weight of water, that is to say, to each pound of this mixture is added a pound of water, so that, in weight the resultant is 50 per cent. of the explosive and 50 per cent. of the water. After passing through the evaporator, the resultant contains from 10 per cent. to 15 per cent. of water and from 90 to 85 per cent. of powder, the relative percentages of the ingredients of the explosive powder remaining the same as they were initially.

Each of the seven units of the pump should be of sufficient size, when the pump is operated at about one hundred revolutions per minute, that each unit delivers about 200 lbs. of the mixture per hour. The seven tubes thus deliver an amount of the explosive sufficient to make about 700 lbs. of powder per hour.

The explosive mixture after treatment in the evaporator falls upon the conveyer v which will carry it to a drier.

In my apparatus as may be seen during evaporation, instead of carrying the entire volume of the mixture through a series of evaporating tubes, it is divided up and each division carried through a single tube, thus making the result more certain, better and more rapid. Further, all the material is forced to the inner periphery of the evaporating tube, thus insuring it receiving like treatment of heat and rubbing and working.

I do not herein claim the apparatus herein described, as the same forms the subject matter of an application filed contemporaneously with this.

Having now fully described my invention, what I claim and desire to protect by Letters Patent is:

1. The herein described improvement in the process of evaporating explosive mixtures in a tube surrounded by a heating medium and containing a screw conveyer, which consists in rotating the conveyer so rapidly as to produce centrifugal force sufficient to drive the particles attaching or tending to attach to the screw toward the inner wall of the tube.

2. The herein described improvement in the process of evaporating explosive mixtures, which consists in subjecting the material in a tube to the action of centrifugal force sufficient to drive the particles to the periphery and heating and carrying said particles through said tube while subjected to a rubbing action.

In testimony of which invention I have hereunto set my hand, at Wilmington, Del., on this 16th day of November, 1908.

FRANCIS I. DU PONT.

Witnesses:

WM. STANIAS,
GORDON L. NAYLOR.