June 29, 1926. 1,590,598

E. TAYLOR

MAKING SMOKELESS POWDER AND THE LIKE

Original Filed March 11, 1920 2 Sheets-Sheet 1

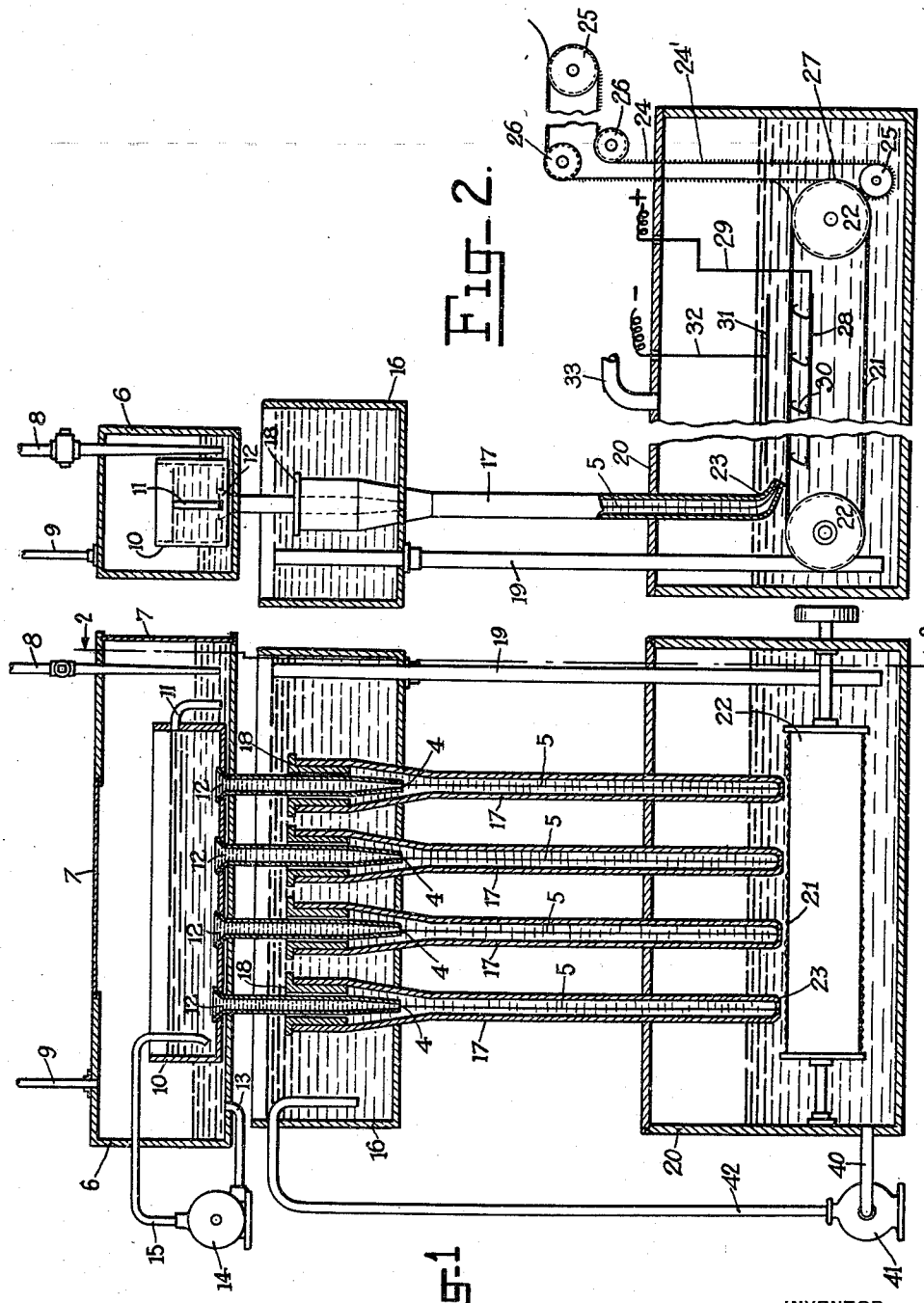


Fig. 2.



Fig. 1

INVENTOR

Edwin Taylor

BY

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ATTORNEYS

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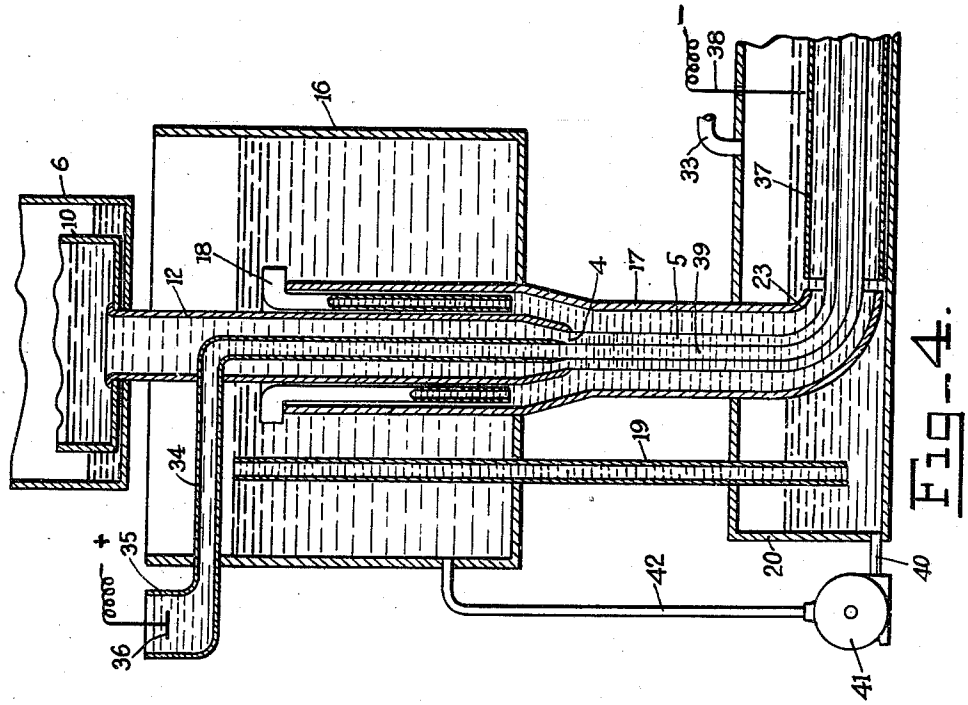



Fig. 4.

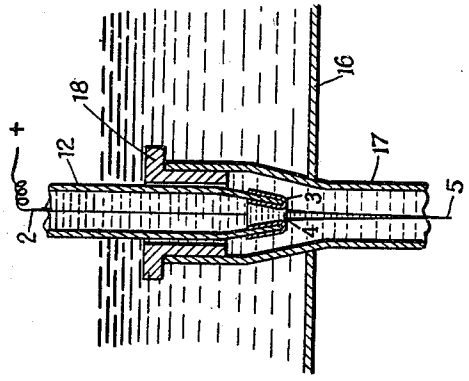



Fig. 3

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Patented June 29, 1926. 1,590,598

# UNITED STATES PATENT OFFICE.

EDWIN TAYLOR, OF BROOKLYN, NEW YORK, ASSIGNOR TO TAYLOR LABORATORIES, INC., OF NEW YORK, N. Y., A CORPORATION OF NEW YORK.

## MAKING SMOKELESS POWDER AND THE LIKE.

Original application filed March 11, 1920, Serial No. 364,980. Divided and this application filed June 17, 1924. Serial No. 720,519.

My invention relates to improvements in making smokeless powder and the like. The main object of the invention is to provide a more simple and efficient method of making smokeless powder and the like from suitable organic material such as waste cotton, carbohydrates such as starch, etc. Further and more specific objects, features and advantages will more clearly appear from the detail description given below taken in connection with the accompanying drawings which form a part of this specification. This application is a division of my prior application Serial No. 364,980, filed March 11, 1920.

In the manufacture of smokeless powders, for instance, it is customary to wash and dry the raw cotton, nitrate it to any desired degree, remove the acid mixture by various methods, wash, pulp, boil and otherwise stabilize the resulting nitro-cellulose, remove the water by drying or displacement with alcohol or the like, gelatinate it or render it colloidal by means of expensive volatile solvents, thoroughly incorporate it together with other materials if desired, in heavy mixing machines, remove and recover part of the volatile solvent, form the gelatinized material (by heavy rolls or hydraulic presses) still containing enough solvent to render it plastic cutting the formed material into grains, etc., of the required dimensions, and drying in expensive dryers to recover the remaining solvent as far as may be. The whole process is expensive owing to the number of operations, the heavy and expensive machinery required, and the labor and capital involved.

According to my process a simple solution of the organic materials is electrolyzed to remove solvent constituents and the resulting product then nitrated. The cellulose material may be formed, granulated, etc., before nitration thereby eliminating the use of volatile solvents for converting the nitro-cellulose from the fibrous to the colloid state as is done at present. The material may be used for coating special smokeless powders.

By my new process, raw cotton or other cellulose may be dissolved in, for instance, the well known cupro-ammonia solution and filtered under pressure. Washing and drying of the cotton are unnecessary as the natural oils or resins, or oil or grease accidentally acquired, which would interfere with nitration, are in this case saponified, etc., by the ammonia solution, and are removed during subsequent operations, while the grosser impurities are left behind on the filter bed. I prefer to effect the solution at a comparatively cool temperature, say about 40° F. and keep the solutions at or about this temperature subsequently. After passing the filter, the cellulose seems to be in typical colloidal solution. In any event, if this more or less viscid solution be placed in a swinging bucket centrifugal, and "whizzed" for a few minutes, the solution at the bottom of the buckets will be found to be materially concentrated, while oil, grease, etc., together with a comparatively dilute cellulose will be at the top. The top layers with any oil are removed, and the cellulose separated from oil, etc., and returned to fresh solutions. The concentrated cellulose is now ready for the forming operations, removal of solvent constituents, etc., as outlined above.

While the cellulose material may be formed by electrolytic decomposition in accordance with the methods described in copending applications Serial No. 314,102, filed July 29, 1919, or Serial No. 341,953, filed December 2, 1919, I prefer to use substantially the method illustrated in the accompanying drawings in which

Fig. 1 is a vertical section through an apparatus for forming filaments or rods of the material;

Fig. 2 is a section taken at right angles to Fig. 1;

Fig. 3 is a section illustrating a modified form of die nozzle; and

Fig. 4 is a vertical section illustrating an apparatus for forming tubes.

6 is a closed tank provided with plates of of glass 7. 8 is a pipe for filling under pressure, and 9 is a pipe for the ammonia. Inside of the tank 6 is a second tank 10 fitted with an outlet 11 reaching nearly to the bottom of tank 6. 12 is a series of outlet nozzles of uniform dimensions provided with outlet orifices 4 of exact size and preferably made of glass extending through the bottom of both tanks. At the lower part of tank 6 is an outlet pipe 13, connecting with a circulating pump 14, which in turn connects with pipe 15 extending through the wall of 6 and nearly

to the bottom of tank 10. Below is another tank 16, provided with downwardly extending draft-tubes 17 of larger diameter at their upper extremities and of somewhat funnel-shaped contour. The nozzles 12 extend into the draft-tubes 17, to points somewhat above the commencement of smallest diameters of 17. The nozzles 12 are centered and held spaced in the upper ends of tubes 17 by a series of solid or hollow separators 18, which also serve to prevent swirling of the flow of liquids passing between the nozzles and the tubes. Tank 16 is provided with an outlet tube 19 extending downward from a point above the level of the tubes 17, and the spacing partitions 18 nearly to the bottom of another closed tank 20. Tank 20 is provided near the bottom with an outlet pipe 40, connecting with a circulating pump 41, which is provided with a delivery pipe 42, extending to a point near the bottom of tank 16. Slightly above the bottom of tank 20 is an endless metallic screen or belt 21, driven at a constant speed upon the drum or roller 22. The draft tubes 17, extending downwardly from tank 16 are preferably provided at their lower extremities with curved ends 23, so disposed that material issuing from them will be deposited on or silghtly above the belt in a direction parallel to the belt movement. Near the further end of tank 20 and approximately at right angles with belt 21 is a second endless belt 24 made of suitable fabric and provided on its outer surface with short rather stiff bristles 24'. This belt drives at the same speed as belt 21. It is driven by means of rollers 25 over guide rolls 26 and contacts with belt 21, at some determined point say 27, its object being to brush off and lift any material adhering to belt 21. Below the upper surface of belt 21 is a metallic bar, or plate 28, provided with an electrical connection 29, and a series of contact strips or shoes 30 brushing against the underside of the belt 21 and causing it to become an anode during operation. Above the belt 21 and separated from it by an appreciable distance is a metallic plate 31 substantially the width of the belt, provided with an electrical connection 32. Plate 31, during operation becomes the cathode of an electrical circuit and may be of zinc, copper, nickel, etc., to favor the deposition of the metallic solvent constituent employed. A pipe 33 is provided through the top of tank 20 by which the gaseous constituents may be removed by suction.

The operation of the apparatus is as follows: Tank 6 is partially filled with a cellulose solution, which for illustration may be cupro-ammonia solution, the circulating pump 14 is started and a constant and predetermined pressure placed upon the tank contents through pipe 9, cellulose solution may be added from time to time and in the case of ammonia solutions, I prefer to use ammonia gas to produce this pressure. When using other solutions an inert gas such as nitrogen is preferable. Tank 10 and the nozzles 12 are filled by the action of the pump until the liquid overflows through pipe 11 back to tank 6. The delivery of the pump 14 is at all times greater than the delivery of solution through the orifices 4 of the nozzles 12, the result being a constant head and a constant and exact delivery of cellulose solution through the orifices of the nozzles.

Tank 20 is filled with a very dilute solution of sulphuric, nitric, or acetic acid. I have found in practice that from ¼ to ⅝ of 1 per cent acid is sufficient. Tank 16 is also filled with this solution by means of pump 41 and its connections. This pump also is of such size that its delivery at all times is greater than the combined deliveries of the tubes 17, the acid solution rising above the tubes until it reaches the level of the overflow pipe 19 by which the excess liquid pumped is returned to tank 20. The upper level of pipe 19 is far enough above the openings of the tubes 17 to prevent the downrushing liquid from drawing air, etc., with it from the surface and so breaking the continuity of the column. The separators 18 also add to this continuity by preventing swirling and insuring a parallel uniform, smooth flow, the object being to obtain a series of columns of liquid flowing downwardly at a constant and uniform speed. As these steadily flowing columns pass the orifices 4 of the nozzles 12 they envelop the streams or threads of cellulose issuing therefrom at a purposely slower speed, and by the friction in passing, tend to accelerate the cellulose to an equal speed. This acceleration puts the viscous cellulose under tension and causes it to elongate or stretch with a consequent diminution in diameter. The amount of this stretch and the consequent diameter of the filament, is a resultant of several factors. The size of the nozzle orifice, the temperature and viscosity of the cellulose solution and the pressure upon it, the length or "head" and consequent speed of the descending column of dilute acid and the strength of the acid, have each a bearing on the size and character of the issuing threads 5, any variation in any one, causing a corresponding variation in the finished filament. Any well known means may be employed for keeping the various solutions at an approximately constant temperature.

If the acid solution used is just strong enough to prevent dilution of the cellulose or other organic material by the water present, it is evident that the threads or fila-

ments 5 during their passage through tubes 17 will remain in a gelatinous or viscous condition still tending to elongate under the tension caused by the downflowing acid. If on the other hand this solution is increased in acidity, a coating of cellulose hydrate will be formed almost immediately, covering the threads with an almost rubber-like tube and limiting the drawing or stretching to a point comparatively close to the orifices of nozzles 12, thereby resulting in a thicker filament. Almost the same result may be obtained by increasing the pressure in tank 6, thereby increasing the flow of cellulose and decreasing the pull or tension of the descending acid by the nearer approximation in speed of the cellulose threads and the acid column but in this case by using the most dilute acids, preventing the formation of any appreciable covering of cellulose hydrate.

The filaments 5, together with the acid water now pass through the curved extremities 23 of the tubes 17, the filaments being carried forward and held in a direction parallel to one another and to the movement of the belt 21, by the rush of the outgoing acid liquid. At this point the filaments pass into an electrical field between the belt, which is an anode, and the metal cathode 31, the cellulose threads being drawn to the belt and remaining in contact with it during their passage through tank 20, the copper or other metal being deposited on the cathode, and the volatile constituent released at the same time by the current. The directional flow of the liquid emerging from apertures 23 is important as by its means, if breakage of a filament should occur during forming or descent through the draft tube, the end behind the break as it emerges from apertures 23 is held in the electric field and parallel to the belt until it adheres to the same, and in position to be picked up by belt 24. After passage through the electric field, which may be as long as required depending upon the length of tank 20, belt 21, etc., the threads or filaments 5, now deprived of solvent constituents and consisting of practically pure cellulose with a glass-like appearance and lustre are brushed from belt 21, on to belt 24, and are carried upon the bristly surface of this belt to the washing operations, being finally lifted from it on to reels, etc., in a condition permitting of further treatment or use.

Slight modifications in results may be obtained by keeping the cellulose constantly in an electric field even during forming and stretching, in which case I employ a modified nozzle shown in Fig. 3, in which 12 is the nozzle, inserted in the draft tube 17, and centered as before by the separators 18. The end of the nozzle is provided with a coating or cap 3 of platinum, through which is formed the orifice 4, of any desired dimension. The platinum cap 3 is connected by a suitable wire 2, to the positive side of an electrical circuit and becomes an anode, the current traversing the thread and the descending acid water to a cathode similar to 31, Fig. 2. The belt arrangement is similar to that in Fig. 2, a separate current being passed from belt 21 to electrode 31, or the same source of current may be employed by placing resistance in the belt circuit equal to the resistance of the column of liquid between electrode 3 and cathode 31. Electrode 3 may be placed in the organic solution itself but the arrangement is apt to block orifice 4, on account of the dropping of particles of cellulose, etc., which may have deposited upon it and for this reason the platinum cap 3 is preferred. By this electrode arrangement the cellulose thread or filament lies in an electrical circuit from the time of forming or drawing to the time of complete solvent removal.

For the production of tubes of cellulose, somewhat similar apparatus is used, as shown in Fig. 4. The same arrangement of tanks, circulating apparatus and overflow systems to secure constant flows and heads on both cellulose or other organic material and acid being retained. The nozzles 12, however, are fitted with a centrally located tube 34, extending from the nozzle orifice 4, upwardly till above the level of the liquid in tank 16, then through the wall of 12, to a suitable reservoir 35, provided with an electrode 36. The lower tank 20, contains one or more tubular metallic electrodes 37 split through longitudinally to permit removal, and provided with suitable connections 38 to cause them to serve as cathodes while in use.

During operation a steady stream of dilute acid is kept flowing through the draft-tubes 17, by means of pump 41. Cellulose solution from tank 6 is forced through the orifices 4 of the nozzles 12 at a slower rate than the speed of the liquid in the draft-tubes, the cellulose tending to assume a tubular form on account of the presence of the end of the tube 34. At the same time water containing only enough acid to cause it to conduct an electric current is caused to flow from reservoir 35 through tube 34, to the center of the cellulose solution issuing from the orifices 4. The liquid coming from tube 34 performs two functions: it prevents collapse of the tube of viscous cellulose and by means of a current from electrode 36, serves as an anode 39, during forming and drawing of the cellulose tube and throughout the removal of the solvent constituents. The viscous cellulose tube 5 caught between the descending columns of liquid, is put under tension by their friction

in passing and its speed accelerated with a consequent elongation and a reduction in the thickness of the tube wall. Almost any desired size of tube may be obtained by variations in size of tube 34, of the orifice 4 and by the relative speeds of the cellulose solution and of the descending columns of liquid. After passing down the draft tube 17, tube and liquids pass through a directional outlet 23, at the extremity of 17, and thence through the tubular cathodes 37, where the solvent constituents are removed as before noted. The finished tube after passing the electrode 37 is wound on reels or cut to suitable lengths for handling as it emerges, is washed well in running water and is ready for further desired operations or uses. It is apparent that variations in the cross-section of the finished tubes, oval, square, hexagonal, etc., may be closely approximated by corresponding variations in the various tubes, nozzle orifices and draft tubes.

It is obvious that in place of employing a single central tube 34, a plurality of such tubes, spaced as desired may be used and the solution of organic material between and around them, the finished material having a corresponding number of holes or perforations of the same general shape as the cross-sections of the tubes 34 and nozzle 12 at their outlets. This is particularly adapted for the manufacture of multi-perforated smokeless powders.

After forming into sheets, rods, tubes, etc., the cellulose is partially dried and may be now "granulated" by cutting machines in the same manner as smokeless powder. This cutting is best done while moist to prevent possible fracture of the edges of the grains.

At this stage several modifications of treatment may be practiced. If a dense powder is desired the grains are thoroughly dried, and thrown (preferably in a continuous stream) into a mixture of nitric and sulphuric acids of a strength required to produce the degree of nitration desired. After nitration is completed the grains are placed in cylindrical vessels perforated at the bottom and the acid removed by displacement by dilute acid, preferably in several steps, until finally the grains are immersed in a dilute acid. The excess acid is now removed by a centrifugal, the grains washed in running water and finally boiled, stabilized and dried. The result is a smokeless powder with a tough, dense grain with a glass-like appearance.

Should a more porous, quicker burning powder be desired, the grains are immersed in the nitrating mixture while still moist and after nitration are "whizzed" to remove adhering acid, and are then thrown into water and washed, stabilized and dried as before. The presence of water in the grains before nitration and its absorption and displacement by the nitrating acids and the displacement of the nitrating acids by water subsequently, produce a grain of very uniform porosity, quite tough and of a translucent appearance, it being borne in mind that the grain was a distended permeable body at the time of immersion in the acids, owing to its water content.

Where an extremely porous grain is desired such as in the so-called "bulk loading" powder, the cellulose is dissolved as before but no effort is made to concentrate the solution. The dissolved cellulose is placed directly in a closed electrolytic cell and the current turned on, whereby the cellulose is deposited on the anode in a white coherent mass which may be several inches in thickness. If the cupro-ammonia solution be used, the copper is deposited on the cathode, and the ammonia may be recovered from the upper part of the cell. After deposition of the cellulose and copper is complete, the mass of cellulose is broken up, washed and put through a centrifugal. The moist mass is now roughly granulated and coagulated by passing through sieves together with a current of acidulated water. The water is now displaced from underneath by the nitrating acids, which are in turn displaced by water and the grains washed, stabilized and dried. The result is a white, porous, clean burning grain well adapted for shotguns or light small bore rifles or for revolvers.

Any admixture of other materials or of other nitro-compounds may be made with the cellulose solution before forming and nitrating, provided these compounds are not decomposed by the solution employed. For instance, a very satisfactory powder may be made by nitrating cotton to a point where it contains approximately 13.2% N., pulping it to a desired fineness and adding it while wet if desired to a cellulose-cupro-ammonia solution in the proportion of 25 parts dry nitro-cotton to 75 parts of dry cotton. The gun-cotton being insoluble in the cupro-ammonia remains in the fibrous condition throughout the various operations, the final product being a grain composed of partly fibrous nitro-cellulose and partly colloidal nitro-cellulose, the latter of a different degree of nitration from the former.

Satisfactory results have also been obtained by immersing the dried cellulose grains in glycerine until they have absorbed a predetermined weight and subsequently nitrating in an acid mixture suitable for the production of nitro-glycerine.

In regard to the percentage of nitrogen taken up during nitration by the formed colloidal cellulose used in this process compared with clean cotton, I have found that there is but little difference in the total amount absorbed from a given acid mixture.

The time of nitration however is longer than with cotton and so is the time required to wash and stabilize it, depending largely upon the thickness of the grain. Any of the well known neutralizing or stabilizing agents such as urea, and the various aniline derivatives may be employed as is done with nitro-cotton, etc. The heat generated during nitration is released more slowly from these formed grains than from fibrous cotton, and is therefore more easily controlled or absorbed and nitration at high temperatures may be readily conducted without danger of "firing." The finished powders are no more hydroscopic than similar powders made by present methods and they have in general a better appearance and are better ballistically owing to the grains being cleaner cut and less deformed.

Practically all of the above methods may be continuous. A ribbon or cord for instance may be formed, the cellulose solvents recovered, nitrated, stabilized and finally granulated by merely passing the formed cellulose through successive baths, etc., by well known means.

In the manufacture of tubular smokeless powders, it is sometimes desirable to have an outer coating having a slower rate of burning for the purpose of increasing the gas volume liberated per instant of time as the grain burns. This is accomplished by first forming a cellulose tube, nitrating the same and finally passing it through the above apparatus, washing, drying, etc., whereby a dense layer of cellulose having a very low burning rate is firmly deposited on the explosive tube, the coated material being cut to grains of any desired length while still moist.

The process is particularly adapted to the manufacture of nitro-starch, having an explosive value nearly equal to nitro-glycerine, heavy and dense thereby packing into a small volume and far cheaper to manufacture than nitro-glycerine. It may be used either wet or dry and in either state is far less sensitive than dynamite. If its explosive strength is to be reduced so as to correspond to 40%, 60%, or 75% dynamite, I prefer to accomplish the reduction by merely adding proportionate amounts of finely divided cellulose or starch obtained by this process, adding the same in either a wet or dry state. The fineness of subdivision is maintained during and after nitration by either starch or cellulose, there being no tendency to adhere and on account of this fineness uniform nitration and subsequent stabilizing are both rapid and easy.

For washing the cellulose after it is formed and electrolyzed and filtered soft water will do. As to the strength of acid employed for supporting the former cellulose this is a variable factor depending upon whether the cellulose, etc., is subjected to the electrolyzing current during the formation of whether the formed material must be transported some distance before coming under its influence. It is best found by experiment for any particular case although I have never used above ¾ of 1% and from ¼ to ½% is generally sufficient of sulphuric acid.

For the purpose of acidulation, particularly with the ammonia solutions, I prefer to use nitric acid as its ultimate product under electrolysis is always ammonia. The bath may be kept to strength by the simple addition of nitric acid, the ammonia released from the organic solution or formed by electrolysis being readily drawn from the top of the tanks and directly recovered, and any residual acid easily removed from the cellulose, etc., by washing.

Definite figures on the electrical current employed are also difficult to give an account of the many variations of the general process. A direct current is preferable; a pulsating current in one direction gives good results but takes a longer time. The problem is an electro-chemical one and the rate of deposition of both cellulose and metal is a function of the amperage rather than of voltage. For cathodes, a metal similar to the one used in the solvent, copper, nickel, zinc, etc., should be employed. With a little attention to the amperage passed all these metals may be deposited in a somewhat spongy condition and while adhering well to the cathode, may be easily scraped therefrom in a condition to be readily re-dissolved for the preparation of new solutions.

For dissolving the organic material, cellulose, silk, etc., if the solution is to be an ammoniacal one, I prefer to saturate 30% ammonia water, free from carbonate of ammonia etc., with hydrated cupric or nickel oxides. The solutions are filtered through fibrous nitro-cellulose, cooled to about 40° F. and saturated with the material to be dissolved in suitable mixing machines. The amount of material dissolved depends largely upon the fiber, etc., used varying somewhat with each different quality or grade of the same kind of material. Some raw cottons for instance will completely dissolve in the proportion of 1 lb. cotton to 20 lbs. of cupro, while with other varieties, 1 lb. cotton to 35 lbs. solution is the best that can be done. When using zinc chloride, I employ a saturated solution of the C. P. salt in distilled water, these solutions being even more sensitive to impurities than the ammonia ones and more difficult to handle and recover.

After solution is complete the viscous mass is allowed to stand for about 24 hours, during which time it becomes much more fluid and may be forced through a filter by means

of pressure. A fine sand bed on top of a layer of nitro-cotton, which in turn is supported by a fine wire screen is quite satisfactory. When desired the solutions are now concentrated by centrifugal action.

At this stage other ingredients may be added to the more or less fluid solution. For instance, if a saturated solution of cotton, or other cellulose in cupro-ammonia is employed it is evident that if more cellulose, say in a fibrous but rather finely divided state be added, this latter addition will be practically unaffected by the solution but it will increase the viscosity of the mass, necessitate a higher pressure to force it through the nozzles or dies and will materially reduce the shrinkage or drying, the result being a material of practically the same chemical composition throughout, part of which is in the fibrous or cellular condition and part of which has been solidified from a colloidal condition.

The variation in finished material which may be produced by these admixtures is almost unlimited, the smokeless powder containing celluloses or different degrees of nitration and in different physical condition as mentioned above, being a good example.

None of the above products are hydroscopic in the strict sense, remaining dry to the touch and preserving their shape under any condition of atmospheric moisture. In common with all celluloses, however, when immersed in water, they absorb a definite amount, swelling somewhat and increasing in length but without losing strength or general shape, and returning to their original dimensions when dried.

It is this property of absorbing water while still retaining shape, the state of so-called "solid solution", which permits of the ready displacement and removal and ultimate recovery of the solvent constituents, copper, ammonia, etc., by the electrical current, aided by osmosis or dialysis through the substance of the formed cellulose.

The tendency to absorb water when in direct contact with it, of the various formed products may be greatly reduced by prolonged boiling or steaming in various volatile solvents for instance, amyl acetate particularly if mechanical pressure be applied at the same time. In my methods hereinbefore discussed, I am not limited to the use of acids for a supporting medium. Solutions of sodium chloride, ammonium chloride, or in fact of any salt that will not readily mix with or chemically affect the cellulose solutions may be employed. Ammonium nitrate gives splendid results and may be preferred, as its ultimate product under electrolysis is ammonia which may be used over and over again.

While I have described my improvements in great detail and with respect to preferred embodiments thereof, I do not desire to be limited to such details and embodiments, since many changes and modifications may be made and the invention embodied in widely different forms without departing from the spirit and scope thereof in its broader aspects; hence I desire to cover all forms and embodiments coming within the language or scope of any one or more of the appended claims.

What I claim as new and desire to secure by Letters Patent, is:

1. The method of making smokeless powder which consists in forming a solution of cellulosic material, removing solvent constituents therefrom by electrolysis and nitrating the resulting cellulose.

2. The method of making smokeless powder which consists in dissolving cellulosic material, electrolyzing the solution to remove solvent constituents therefrom, nitrating the resulting cellulose, removing the excess of nitrating mixture, and finally boiling, stabilizing and drying the resulting product.

3. The method of making smokeless powder which consists in dissolving cellulosic material, electrolyzing the solution to remove solvent constituents therefrom, nitrating the resulting cellulose, removing the excess of nitrating mixture, and stabilizing the resulting product.

4. The method of making smokeless powder which comprises dissolving a suitable cellulosic material to form a solution thereof, electrolyzing the solution to remove solvent constituents therefrom, and nitrating the purified cellulosic material.

5. The method of making smokeless powder which consists in subjecting a colloidal solution of cellulosic material to electrolytic action, drying the resultant electrolized cellulosic material, cutting said material to the desired shape, and then nitrating it.

6. The method of making smokeless powder which comprises forming a solution of cellulose, subjecting the solution to electrolysis to remove solvent constituents therefrom electrolytically and nitrating the cellulose.

7. The process of making smokeless powder which comprises mixing together nitro-cellulose and a solution of cellulose, and subjecting the mixture to electrolytic action to remove solvent constituents electrolytically.

8. The process of making smokeless powder which consists in forming a solution of cellulosic material, passing the solution through a die into a supporting liquid medium, electrolyzing the solution while in said medium to remove solvent constituents from the cellulose material, and nitrating the cellulose material.

9. A process of treating fibrous or cellular organic material which consists in sub-

mitting a colloid solution of organic material of definite shape immersed in a supporting medium to electrolysis, washing and drying the resultant formed organic material, cutting said material to a desired shape, submitting the cut material to the action of a nitrating acid, thereby converting the shaped and formed organic material into a material having explosive properties.

10. The method of making smokeless powder which consists in forming a solution of cellulosic material, removing solvent constituents therefrom by electrolysis, nitrating the resulting cellulose, and depositing on said nitrated cellulose a layer of material having a slower burning rate.

11. The method of making smokeless powder which comprises coating an explosive material with a cellulose solution having a slower burning rate, and removing solvent constituents therefrom electrolytically.

12. The method of making smokeless powder which comprises dissolving a suitable organic material to form a solution thereof, electrolyzing the solution to remove solvent constituents therefrom, nitrating the purified organic material, depositing thereon a coating of organic material having a slower burning rate, and removing solvent constituents therefrom by electrolysis.

13. The method of making smokeless powder which comprises dissolving cellulosic material to form a solution thereof, electrolyzing the solution to remove solvent constituents therefrom, nitrating the purified cellulosic material, depositing thereon a coating of cellulosic material having a slower burning rate, and removing solvent constituents therefrom by electrolysis.

14. A smokeless powder comprising a cellulosic material coated with a material of slower burning rate.

In testimony whereof I have signed my name to this specification.

EDWIN TAYLOR.

## CERTIFICATE OF CORRECTION.

**Patent No. 1,590,598, granted June 29, 1926.**

**to EDWIN TAYLOR.**

**It is hereby certified that error appears in the printed specification of the above mentioned patent requiring correction as follows: Page 1, line 95, strike out the word "of"; page 2, line 30, for the misspelled word "silghtly" read "slightly"; page 6, line 25, for the word "or" read "of"; and that the said Letters Patent should be read with these corrections therein that the same may conform to the record of the case in the Patent Office.**

**Signed and sealed this 8th day of March, A. D. 1927.**

**M. J. Moore,**
**Acting Commissioner of Patents.**

**Seal.**