J. E. BLOOM.

MANUFACTURE OF LOOSE COMPOUNDS.

APPLICATION FILED DEC. 3, 1917.

1,333,701.

Patented Mar. 16, 1920.

2 SHEETS—SHEET 1.

Fig. 1.

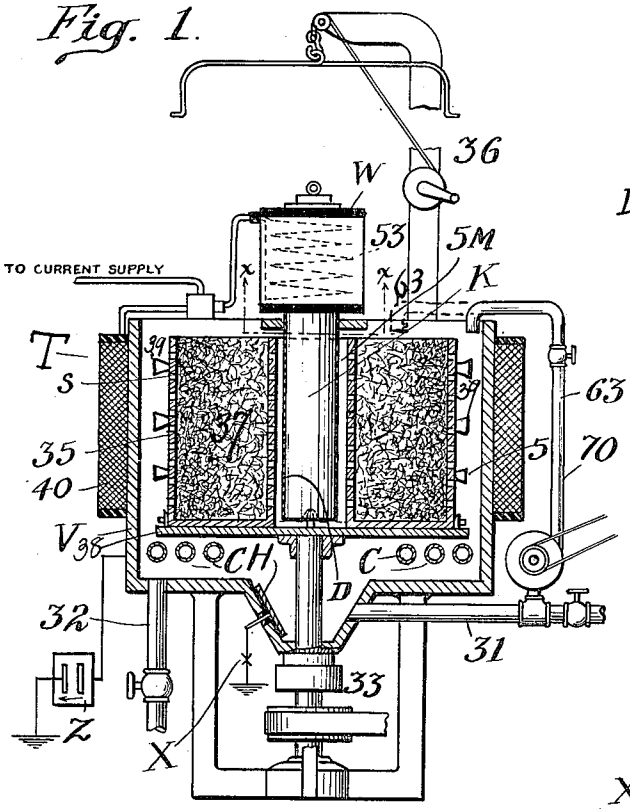


Fig. 2.

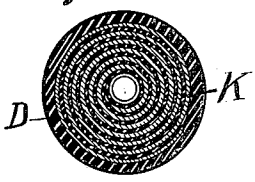
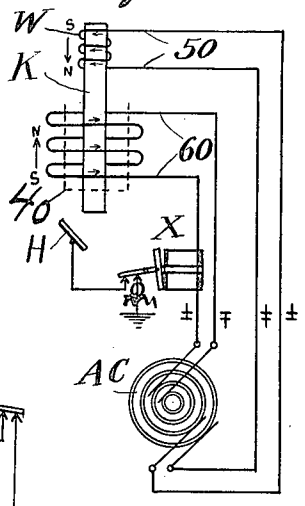
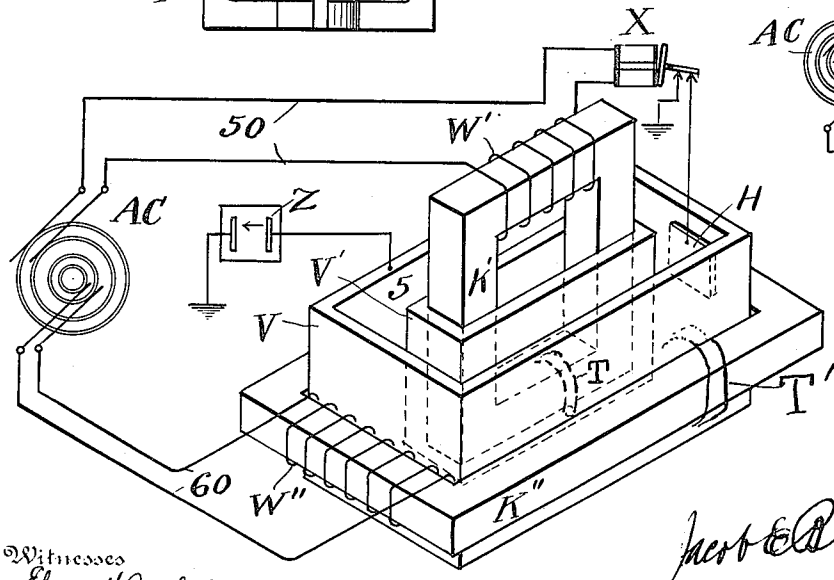


Fig. 3





Witnesses
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Fig. 4.

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2 SHEETS—SHEET 2.

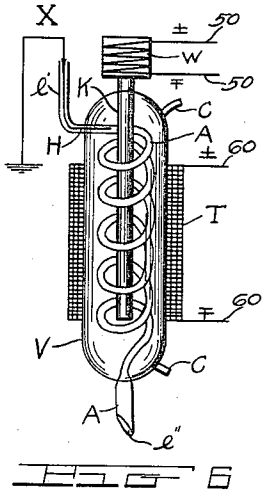

FIG 6

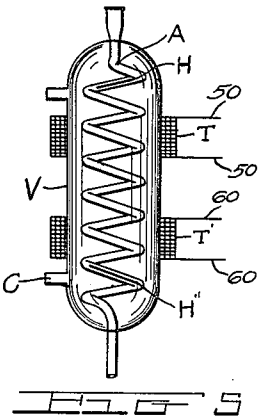

FIG 5

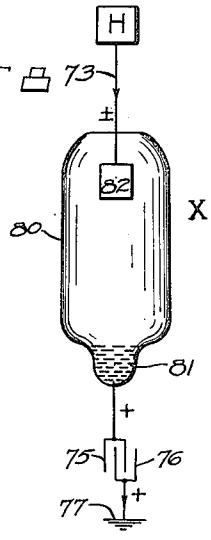

FIG 8

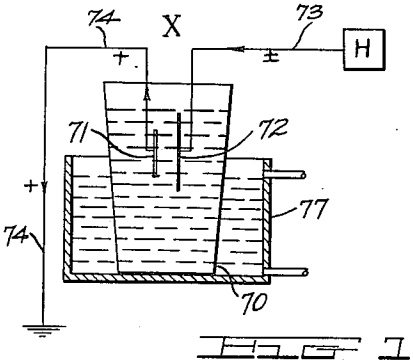

FIG 1

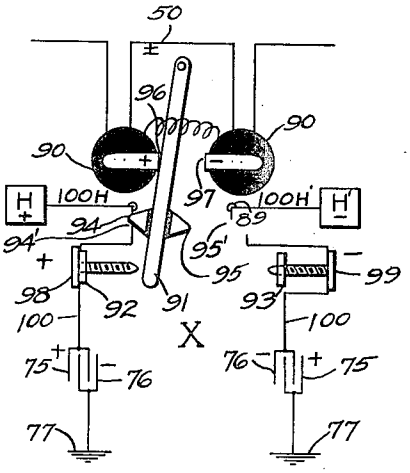

FIG 9

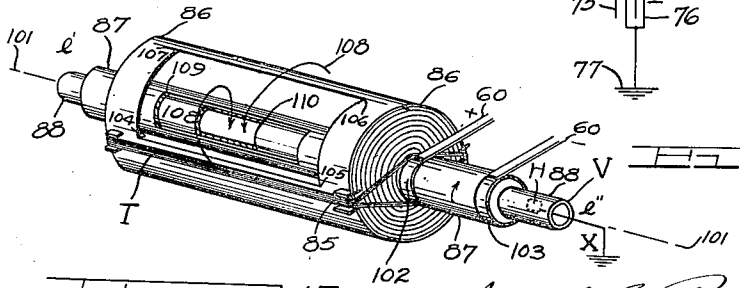

FIG 10

Witnesses.
Elmer H. Buechele.
Victor R. Leary.

Jacob E. Bloom Inventor

UNITED STATES PATENT OFFICE.

JACOB E. BLOOM, OF BROOKLYN, NEW YORK.

MANUFACTURE OF LOOSE COMPOUNDS.

1,333,701. Specification of Letters Patent. Patented Mar. 16, 1920.

Application filed December 3, 1917. Serial No. 205,229.

To all whom it may concern:

Be it known that I, JACOB E. BLOOM, a citizen of the United States, residing at Brooklyn, city of New York, in the county of Kings and State of New York, have invented certain new and useful Improvements in the Manufacture of Loose Compounds, of which the following is a specification.

This invention relates to an electrical treatment in the manufacture of "loose" compounds including explosives; especially any such comprising colloids, or adsorption compounds of loose compounds when dissolved in suitable solvents or dispersed in suitable mobile medium, advantageously illustrated by such as the composite explosives based upon or embodying nitrosubstitution products, with nitrocelluloses or nitroglycerin.

The invention is based on and adapts the properties and principles of electrically charged particles or elements when dispersed in a mobile medium, and electrically charged from an A. C. source, under insulated conditions; as distinguished from the mere electrochemically charging thereof, as of ions, by mere solution; and also on the properties and principles of electric transference and of electric adsorption.

Among its objects are that of making the products more stable and more dense and more in equilibrium and less sensitive than at present, by more firmly and homogeneously fixing and electrically compacting sundry colloids and dispersoids and what are known as "loose" molecules and substances, electrically adsorbed in and from a disperse medium or solution; and including ensuing reaction compounds, colloidal or chemical, upon the dissolved adsorption substances and dispersed particles.

Other objects and advantages are set forth in the body of the specification and claims.

As a process my invention comprises a process of first advantageously making solutions or disperse state in a mobile medium of the materials to be used, in making a compound, and advantageously treating same to attain dispersoid state in an A. C. field; and then blending or mixing the solutions and treating same under insulated conditions preferably in dielectric vessels, by subjecting the same in the liquid state at suitable temperature, to the influence of alternating electric stresses or fields either between electrodes immersed in the solution, or subjecting to the influence of induced electric or magnetic or electrostatic stress or stresses or fields acting within the solution, from exteriorly generated alternating current source, advantageously first from a single phase system, advantageously of low frequency, and in some cases followed by a polyphase system of medium or high frequency;—the latter A. C. currents being arranged in circuits so as to create in the liquid, opposing and conflicting alternating electric fields, of alternations of like frequency and advantageously of like amplitude, voltage and amperage, and advantageously symmetrical, and of flattened top wave form; the circuits from such multiple alternating currents being arranged to act, hammer-and-anvil-like, in the liquid upon the soluble or dispersoid substances in the liquor, and the liquids being under control as to temperature and movement or agitation; simultaneously the liquid solution is advantageously passed intermittently or continuously with suitable pressure through the A. C. field whose lines of force are nearly at right angles to the lines of flow of the liquids, under insulated conditions; or the solution is agitated therein under insulated conditions and under regulated periods of time, and temperature, a greater or less period of time, at higher or lower temperature, such being varied for the differing compounds or ends to be attained.

Alternatively, the solution may be passed through the A. C. fields intermittently, or continuously, under regulated temperature and time and speed of passage.

Alternatively, only a single A. C. stress is to be first applied, of low frequency; and thereafter in some cases follow the operation by applying the opposing A. C. stresses of the polyphase system of higher frequency.

In some cases the solution, if not so naturally, is advantageously first made slightly acid by the addition of suitable acids; and thereby, some colloids or dispersoids become negative; and the above electrical treatment is then applied, resulting in the fixed adsorption of the emulsoid or dispersoid positive particles by the negative from solution; and again or thereafter in some cases, a solution is prepared to be basic or alkaline by the addition of suitable salts or alkalis; and in which the sundry colloids or particles or dispersoids

become positive; and then the electrical treatment is again applied resulting in the adsorption of negative particles, or of suspensoids previously rendered negative by immersion or by above first treatment; and become fixed in the second treatment, generally by combining and compounding with other dispersoids or colloids or ions of opposite sign to form colloidal or dispersoid or other chemical compounds; if the emulsoids or amphoteric substances are not thereby fixed, such are electrically repelled and continue in solution. In some cases, the foregoing treatments are reversed, *i. e.*, said second treatment is first used. In other cases, such second or the preceding treatment only is used. The operation is advantageously conducted under insulated conditions, during the periods of time when the currents are applied; or the liquors, when the single phase A. C. field is alone applied, then advantageously having intermittent earth or discharge connection through an insulated grounding wire having an exterior interrupter passing or transmitting to earth only free positive charges and leaving a negative charge upon particles in the liquid or the adsorbent dissolved therein; or vice versa; the same treatment being conducted advantageously until the suspensoid colloids and adsorbable dispersoid particles have been firmly electrically adsorbed from the solution by other particles oppositely charged and thereby firmly compacted or fixed; and until gases have been forced out thereby; *i. e.*, by the alternating forces of the A. C. fields.

Alternatively and furthermore such treatment may in some cases be applied advantageously both before and during the mixing or compounding process proper *i. e.*, first: apply the electric stresses before blending liquid components or solutions in order to prepare the liquor most advantageously by thereby and therein attaining homogeneous electrical adsorptions and fixedness with less sensitiveness and perfecting a more minute dispersion of the dispersoids and adsorbable colloids; and secondly, then applying the electric fields during the blending or mixing of all the liquid components in order to cause further and firmer adsorption and fixation of compounds in a homogeneous manner.

The first treatment of the separate component liquids alone may be in some cases dispensed with, and the latter treatment of the blend or mixtures may only be used.

It will be understood that this process may be repeated several times if desired, or in several successive vessels, depending upon the effects to be obtained, and with A. C. of low or medium or high frequency, and of varying strength; and with or without intermittent ground connection from the insulated liquids being treated, to earth through an insulated interrupter as herein described.

As an apparatus, my invention comprises a vessel or vat or chamber thereof, advantageously constructed or lined with glazed porcelain or stoneware or glass or other dielectric, and acid or alkali resisting material, the whole supported on insulating material, together with means for supplying to, circulating in, and across the lines of force of an A. C. field and then removing from said vat, a suitable solution or liquor, *i, e.*, having a suitable stuff or element in solution, or in disperse state therein, with particles advantageously adsorbable and colloidal or dispersed in suitable mobile medium; and having means for controlling the temperature of the liquor advantageously to about 130° F. and in some cases to about 30° F., where the solution or disperse medium remains liquid at such temperature and otherwise about 32 to 30° F.; and in some cases with means for the agitation or movement thereof or passage thereof through the vessel, and to make contact with the electrodes or induced A. C. fields; and with means for supplying to, immersing in and removing from said vat, the liquid to be treated, advantageously between A. C. electrodes; and means for effecting such passage, advantageously between suitable A. C. electrode plates, made of material neutral and insoluble, and advantageously hollow; and in some cases the electrodes carrying a cooling solution insulated therein; means for controlling the period of time of such immersion and passage, and an intermittently insulated condition thereof; means for producing and maintaining in said vat and for subjecting said liquor while moving therein, to the influence of stresses in alternating electric field or fields from exteriorly generated alternating current source, of regulable frequency voltage and amperage, advantageously first from single phase low frequency A. C. and followed by polyphase system of medium or high frequency A. C. advantageously symmetrical and of like frequency, advantageously of like amplitude and flat top wave, and like voltage and amperage, with the latter circuits arranged to create in the liquid conflicting or opposing alternations of equal magnitude either in induced A. C. fields, or between sets of suitable insoluble inert electrode terminals of large and equal area, immersed in the solution, advantageously close together and with the liquids passing therebetween; and means for controlling said A. C. fields; means for keeping the liquid and the apparatus under insulated conditions; means for electrically connecting to earth the liquor or solution in said vat, when said A. C. stresses are applied, through an electrode-like plate

or wire in the liquid, called a leader plate, connected to an insulated wire leading to earth, through an insulated interrupter, adjustable to allow only positive or only negative alternations to pass to earth, (and advantageously in synchronism with the above A. C. in liquid), as for instance, through an electrolytic rectifier or like device permitting positive charges only to be grounded automatically.

In one form, I advantageously provide separate circuits for each of two-phase currents differing in phase angle by about 180 degrees or otherwise, so as to set up opposing or conflicting alternations in the liquid; and by providing separate terminals or sets of insoluble inert electrodes having advantageously equal surface area, in the vessel for each circuit; and I prefer to arrange such electrodes by placing the anode of one circuit to face and oppose as nearly and closely as practicable, the anode of another circuit; and cathode electrodes ditto, but more distant from the anodes or insulated from the latter by the mass of the liquids intervening to avoid short circuiting; and thereby so arranged, that practically the circuits or alternations in the liquid flow in conflict or across each other or in opposition,—*i. e.*, the positive (or negative) alternation of one circuit being practically met and opposed in the liquid by the simultaneous equal and positive (or negative) alternations respectively of the other circuit or circuits; and which alternations practically meet upon or act hammer-like from opposing sides or conflict upon the adsorbent or adsorption compounds in solution or dispersed therein, interposed between the like electrodes of the several circuits in the liquid.

Thereby in addition to the mere adsorption, there is attained a hammer-like or compacting effect upon and within the compounds in the liquid which aids in the "fixing" and increase of density of molecular compounds, and of adsorptions, and in the "compacting" of the said substances or other adsorbent, and in the driving out any free gases in the liquid, or in its compounds.

The said action and effect are influenced and effected also by the lag of the current behind the voltage and which may be enhanced by placing an inductance in one lead of one of said A. C.'s.

It is advantageous to provide in the A. C. circuits a condition of resonance, and that the circuits each contain inductance, resistance and capacity, in series.

An ammeter and rheostat not shown are placed in each A. C. circuit.

In some cases, I facilitate the earthing of the freed positive or negative pulsations or charges when quite faint after passage through the interrupter, by passing same through a Ruhmkorff coil, or a closed-core transformer or the like, to obtain increased voltage to earth.

As a product, my invention comprises manufactures, such as explosive compounds or the like, and electrical adsorption compounds such as the components used in the making—having and comprising electrically adsorbed therein, from suitable liquids, sundry dispersed particles and suspensoid colloids and irreversible particles and mutual precipitations, and reaction compounds, with or without chemical reaction compounds of said adsorptions with each other, or with the colloidal or dispersoid substances or components, or with other adsorbents; such adsorptions and reactions being formed and fixed and compacted while in solution or disperse state in suitable mobile media, by electrical transference and electrical adsorption and compression in addition to natural adsorption; and all attained homogeneously and in non-strained equilibrium, resulting in enhanced fixed and stable state or conditions, and with increased true density or specific gravity of the adsorbed molecules.

Again, one form of my product may be described as a chemically-sensitive substance, or a compound therewith, which is ordinarily of loose molecular structure and strained equilibrium, but is electrically transformed by the process to a substance of same molecular group or groups but of less sensitiveness, and of firm stable fixed and durable molecular structure, and in non-strained equilibrium.

I illustrate my process by sundry types of nitrogen compounds as such are more especially adaptable to electric adsorption; but I do not restrict the process to such.

In general my improvements pertaining to composite explosives and other compounds are attained as follows:

I first purify the liquids or disperse mediums to be used in the manufacture, as described in my U. S. Patents 1,162,212 and 1,162,213;

I then proceed with the manufacture substantially as at present but using the said purified liquids and medium to first bring the components into a disperse state or solution;

I then pass the compounded blends or mixtures of the liquid compounds through A. C. fields under insulated conditions at suitable temperatures and pressure, with intermittent ground connection through an interrupter to discharge only positive or only negative alternations or charges to earth;

I then complete the manufacture substantially as at present, or using present processes.

In the operation of my process, in some cases where it is doubtful or impractical

to determine in advance or theoretically whether to use an interrupter to pass to earth the positive or negative free or unbalanced charge, then it is advisable to test the product when the negative charges are retained, and again when the positive charges or pulsations are retained the superiority of the one product over the other as regards stability or density or other test will definitely fix the preferable adjustment or kind of interrupter to use, in making the particular product. And likewise as regards the use of an impedance coil in one lead of one A. C. circuit when the interrupter is placed in the other lead of same circuit. And likewise as to whether before the compounding in solution or in disperse state, to first make it acid or alkaline or neutral. And likewise as to the placing or not of an inductive resistance in series in each of the A. C. circuits.

I apply said improved process in the manufacture of "low explosives" such as nitrocellulose, etc., and of "high explosives" such as nitroglycerin, etc., and of nitro-derivatives, and of the nitro-substitution products such as "T. N. T." or trinitrotoluene and picric acid, and nitro-benzene and the like; and sundry composite explosives or powders including as components any of the above with or without addenda, such as the so-called freezing elements, also stabilizers, etc.; and especially the solvents, used; the said composite explosives including such, where the components are or can be brought to a liquid state or dispersed in suitable liquids or so-called solvents.

Scientists agree that in such manufacturing, "success depends largely on the purity of raw materials" such latter including glycerin, phenol, benzene, toluene, napthalene, nitric acid and sulfuric acids, acetone acetic ether, amyl acetate, methyl alcohol, etc. ethyl alcohol, propyl alcohol.

In my process briefly described most of the said and kindred liquids are first purified and refined by the physical electrical treatment described in said patents, and which will largely remove the inorganic impurities, including such as lead and iron salts due to action of acids, etc., on apparatus,—pipes, etc.:—and also remove sundry organic impurities of a colloidal character or which are converted to a colloid state by the said treatment; also removes or condenses "gases," and impurities soluble in the solvent. In addition to removing mere impurities, which affect the stability, the process, *i. e.*, the A. C. stresses, increase the molecular density and changes "loose" structures to a fixed molecular structure. After such purification and stabilizing, I proceed with the manufacture of the explosive as at present excepting mixing or blending the components in solution or in disperse state in my A. C. field.

The nitro-explosive compounds consist of substances whose particles contain within themselves, the carbon, hydrogen and oxygen necessary for combustion, and comprising such in part as molecules, in part as "loose" adsorption compounds or molecules with weak molecular bonds due to NO_2, the group known as nitryl, or other weak-binding radical, acting by adsorption and duly substituted for H in some organic substance; or in other words in combination, physical or chemical, other than mere mechanical mixing or conglomeration; typical examples are what are known as nitro-substitution products and nitro-explosives, including nitrations of the different kinds of cellulose, cotton lignin, etc.; also nitrations with or of glycerin, benzene, starch, sugar, treacle, jute, phenol, wood, straw, paper, etc.

In the nitrosubstitution compounds, the NO_2, groups, obtained from the nitric acid, are directly connected by adsorption to the atoms in the original material, replacing the H; whereas in gun-cotton, nitroglycerin, and the like the NO_2, groups are linked to the C atoms of the original substance by means of atoms of O; but such gun-cotton, etc., when dispersed in a suitable large amount of liquid medium, act by adsorption in the forming of the composite explosives.

Nitro-substitution products or nitroderivatives are used as explosives alone, or as ingredients of explosive mixtures or compounds. As explosives, such are used as bursting charges for explosive projectiles, torpedoes, mines; also for detonators and primers. As ingredients of explosive mixtures or compounds such are used also, to lower the freezing point; and in certain colloidal or gelatinized explosive mixtures or compounds when their properties of forming colloids with the so-called soluble nitrocelluloses, is utilized to produce elastic explosives, *i. e.* explosive gelatin and the like, constituting ideal explosives.

In order to attain stability in the product, it is essential that the coal-tar products, to-wit: the benzene, the toluene, the naphthalene, the phenol (carbolic acid), etc., used in the preparation of the nitro-derivatives, should be of a high degree of purity; and likewise as regards the alcohol, or other solvents, or ingredients in suitable solvents entering into the compounds. Such purity, I advantageously attain by the process herein described or described in my U. S. Patents Nos. 1,162,212 and 1,162,213 for the electrical treatment of liquids, to-wit: by passing same in liquid state through suitable solid comminuted inert adsorption material, in an A. C. field, advantageously the induced fields of low frequency, thereby removing the impurities by electrical adsorption upon the solid adsorbent. I advantageously also follow such by treatment as herein described,

of passage through induced A. C. field of low frequency, and at low temperature, with grounding positive alternations only.

Extremely sensitive substances, such as the diazo compounds, nitrogen halids, and the like, are difficult to manipulate on account of extreme sensitiveness and danger of accidental explosions; such and other extremely sensitive explosives are especially of what is called "loose" molecular structure and strained equilibrium.

My process in many cases, changes, fixes and stabilizes this "loose" molecular structure in the product and effects a transition to and attains more firm and fixed and more stable molecular structure in non-strained equilibrium, by means of or through the instantaneously acting electrical adsorption forces added to the natural adsorptions, of non-amphoteric dispersoids and particles; and the latter adsorptions followed by the A. C. stresses or hammer-like contacts, or compressions upon such natural adsorption structures, or molecular compounds, driving out therefrom simultaneously the amphoteric free uncombined emulsoids and gases which have not become combined.

This view and effect of my process pertains to sundry molecular groups, or structures of sundry atomic groups, now characterized by the more or less ease with which they break down, including such as, to-wit:—

N=N, in diazo compounds; and in hydronitric acid and others; example $C_6H_5N=NONO_2$, diazobenzenitrate. Also N=C, in the fulminates; in cyanogen C_2N_2 and others. Also N=O, in inorganic and organic nitrites; in nitro bodies and others; example $C_2H_5ON=O$, ethyl nitrite. Also N—Cl, in NCl_3, nitrogen trichlorid. Also C=C, in acetylene C_2H_2 and in the polyacetylenes. Also O—Cl, in chlorates, perchlorates and others; example $CH_3O—Cl$, methyl hypochlorite; also the perchlorid of ammonia; also O—O, in ozone; in peroxid and others; example $C_2H_3OO—OC_2H_3O$, acetyl peroxid.

In my electric process, and with the discharge or ground connection adjusted to discharge from the liquid, only the free positive charges, I attain stable electro-negative groups in solution or in disperse state, which effect electrically adsorbed and fastened associations or adsorption compounds, of enhanced stability, in or with the solvents: water,—the alcohols, phenols,—carboxylic acids,—amids and anilids,—exims,—nitriles,—mercaptans,—thioacids and amids,—primary amins,—nitroso compounds,—aldehydes and ketones; and said electro-negative groups include: OH, and COOH, and CONH, and NOH, and CN, and SH, and CSNH, and CSOH, and NH_2, and NO, and CHO, and CO, and CS.

Such stability, etc., pertains not only to sundry organic adsorption compounds thereby electrically fixed, but likewise with sundry inorganic adsorption compounds including sundry oxids, to wit the nitrogen peroxid,—phosphorusoxid in benzene,—arsenious oxid in nitrobenzene,—hydrogen chlorid,—nitric acid.

The mere presence of nitrogen or trivalent nitrogen, or of elements like chlorin, bromin and iodin, oxygen and sulfur, does not bring about these adsorption compounds or associations,—but such are formed when the element is present in one of the electro-negative groups indicated, in my A. C. field.

It is not essential that either or all the constituents of an adsorption compound shall be what is ordinarily known as associated; many such are formed from unassociated constituents; among such organic substances are the compounds of napthalene—phenanthrene and fluorin, with di- and trinitrobenzenes and trinitrotoluene, etc.

I advantageously attain such electro-negative groups with my process using an interrupter passing to earth only surplus positive charges.

In the manufacture of smokeless powder and the like, by my process,—the guncotton is first dissolved in acetone or other solvent previously purified by treatment as prescribed in aforesaid patents; and then blended with the nitroglycerin, etc.,—sufficient of the solvents being used, to attain a thin consistency, or mobile state; the blend is treated as generally described for liquids in the above patents with or without the solid adsorber, and thereafter, the solvents are evaporated, etc., as at present.

The improvements consist in utilizing analogous means as described in said patents, in adapting and practically applying electrical adsorption and without electrolysis,—by substituting in the process,—after the purifying and stabilizing of the elements or components by the process described in said patents; then in lieu of the solid comminuted adsorption material of said patents, substitute the nitrocellulose dissolved in suitable solvent, *i. e.* in making smokeless powders, etc.; or substitute the nitrocellulose dissolved in the nitroglycerin as in making gelatin compounds; and blend in the A. C. field. Solvents previously purified and stabilized by treatment as prescribed in my above patents are used to bring the blend into a liquid state, quite thin, to enable mobility of particles and electrical adsorption of oppositely charged particles. The alternating current field also aids in the mixing, and attaining intimate contact of the molecules and particles in the disperse state or in solution. Thereafter the solvents are removed as at present.

Material additional stability is thereby at-

tained as illustrated in such compounds as the smokeless propellant known as cordite "D," comprising 65% nitroglycerin, 30% gun-cotton, 5% vaseline; the first two are dissolved and then blended in acetone about four times the quantity, or the first thinned in alcohol or ether alcohol, and the second in alcohol or other solvent in larger amount than at present, so as to attain a thin solution through which the A. C. will readily traverse; and simultaneously mix or blend the components (previously thus purified) in the A. C. field; thereafter, the acetone or other solvent is largely removed as at present, (by evaporation or centrifuge) to bring to the state of paste, when the vaseline (previously purified) is mixed therewith as at present;—and remaining acetone evaporated to bring to state of dough,—and then finished as at present.

The "gun-cotton" or nitrocellulose used is preferably not the finished pressed or solid colloid form or state,—but advantageously the freshly made nitrocellulose, prior to the present hydraulic pressing thereof, in order to retain the porous cellular fibrous capillary structure of the cotton fiber in the nitrocellulose, as far as practicable,—and which is advantageous in the electrical adsorption of the nitroglycerin by the nitrocellulose surfaces, resulting in greater density and homogeneity and stability,—and less tendency to subsequent exudation or separation of the nitroglycerin.

Like methods and advantages pertain to applying the same process in the manufacture of other composite nitro-explosives or compounds thereof, or compounds of gun-cotton with or without the lower nitrations of nitrocelluloses; or nitrations of starch,—or gelatin,—or agar, etc.; or the nitro-substitution products including "T. N. T."—picric acid, etc.

Likewise to attain stable high explosive compound of nitromannite, advantageously with alcohol; *i. e.*, with nitroglycerin or other liquid explosive, to wit methyl nitrate or panclastite. Explosives thus treated will not only be superior as regards stability, density and homogeneity upon long storage, or from heat or transportation,—but that further the life of the heavy ordnance firing same may be longer, on account of the absence of corroding impurities.

Another example is trinitrotoluene, $C_6H_2CH_3(NO_2)_3$—briefly called T. N. T.; this is a component of or in many explosive compounds, and is also used alone, either pressed or fused, as a charge for bombs. The preparation thereof, in general, is in three distinct steps; toluene is first converted to mononitrotoluene,—which is then changed to dinitrotoluene,—which is finally nitrated in sulfuric acid solution with strong nitric acid. 100 parts of dinitrotoluene yield about 90 to 95 parts of T. N. T., which is obtained as a mass of large radiating crystals melting at 77° to 79° C. As thus obtained it is not ordinarily pure. After each of said nitrations the compound being an adsorption compound, I advantageously treat the liquids prior to the separation of the T. N. T. in the A. C. fields herein described. Or I treat the crystals by weakening or thinning a solution of the T. N. T. and the like in alcohol or benzene, and treat such solution, by passing the solution over a comminuted solid adsorption material, advantageously electro-positive, in a dielectric chamber, in A. C. fields as described in Patent No. 1,162,212; or in the A. C. fields of low frequency herein described; or treatment in the A. C. fields of low frequency followed by ordinary filtration advantageously through cellulose filters, and thereafter, evaporating the alcohol or benzene as at present; and advantageously under insulated conditions.

Again, my process is advantageous also in the manufacture of so-called "explosive gelatin," and the like, made by combining or blending the soluble nitrocellulose or gun-cotton when dispersed in a suitable liquid solvent with the so-called coal-tar "nitrosubstitution products," in suitable solvents, constituting together a colloidal or gelatinized explosive mixture, after the due evaporation, etc., of the solvents.

I apply my alternating induced electric stresses to the mixture while in a thin liquid disperse or colloidal hydrate state.

Another illustration or type:

When carbolic acid reacts with strong nitric acid, there is formed the nitro-substitution compound called picric acid. One of the processes of manufacturing picric acid, in general, with minor variations, consists in mixing equal quantities by weight of carbolic acid and concentrated sulfuric acid in an iron vessel stirred and heated by steam, at 212° to 250° F. The nitration thereafter takes place in dielectric stoneware or earthen receptacles or vessels, standing in running water, which can be heated by steam pipes or cooled by cooling coils. Three parts of nitric acid with one part of above sulfuric solution gradually added, is placed in these receptacles; at first the reaction is violent; afterward it becomes sluggish; and it is thereafter I apply my system of passage and action in an A. C. field, and before the picric acid separates as a syrupy liquid, and becomes crystalline on cooling. While in such thin liquid state or again when redissolved for purification or compounding, I also advantageously treat the picric acid in liquid disperse state in my A. C. field. And likewise in the subsequent blending or manufacture of picric-acid derivatives or compounds, when dis-

persed in suitable liquids and whereof typical examples are some forms of the English lyddite and the French mellinite, the Japanese chimose; or other mixtures of picric-acid and nitro-celluloses or other nitro-compounds of the aromatic series. Thereby and therein I attain increased "chemical" stability and comparative infrequency of accidental explosions.

It will be noted that picric acid was used as a natural dyestuff for wool and silk, long before its explosive properties were utilized. It and its derivatives are adsorption compounds.

Likewise, in the manufacture of smokeless powders and the like, wherein nitrocellulose or gun cotton is largely used, I also apply my electrical process in the treating and blending of the ingredients after first bringing such N. C. to a very thin disperse state in suitable solvents, before such N. C. is compressed in its original manufacture.

Guncotton and nitroglycerin are the principal components of smokeless powders, and can be mixed or incorporated in any proportion while the guncotton is in a thin disperse state, attained as by dissolving it in acetone of at least four times the quantity, or other solvents or ethyl acetate or benzoate and other ketones and many benzene compounds, most of which are volatile liquids; and all of which solvents, which gelatinize or disperse gun-cotton, also dissolve nitro-glycerin; when the acetone, etc., is thereafter finally evaporated, the nitroglycerin is left behind adsorbed by the gun-cotton jelly, and then also possesses a more or less solid colloidal character. After the dispersing medium, advantageously with diphenylamin, has been added, in amount to attain a thin disperse state, and the nitro-glycerin then mixed therewith, I apply my electric process, because then all the mechanical and electrical operations can be safely conducted; even if the mixture should become ignited, as by contact with a flame, when the mixture burns, but does not detonate or explode.

Nitrocellulose, obtained by the due action of nitric and sulfuric acids on substances containing cellulose, such as cotton, flax, wood fibers, jute, etc., is not a simple chemical compound but is rather a series of nitric acid esters of cellulose comprising: nitrocelluloses of low nitration, characterized by their solubility in ether-alcohol, *i. e.*, collodion cotton, or pyro-collodion; or nitrocelluloses of higher nitration most easily soluble in acetone and glacial acetic acid, *i. e.*, guncottons.

Although by strict adherence to a definite set of conditions or procedure during manufacture, a nitration product of practically unvarying properties is obtainable, yet this is never an individual nitrocellulose, or cellulose ester, but a blending or adsorption of several esters in which one or two predominate. I attain an improved blending of such nitrocelluloses alone by electrical adsorption of the said colloidal esters by and upon each other, while in liquid state in a suitable solvent; and further compressed together through due passage through A. C. fields after the nitration but while still in disperse state in the liquid medium; and which latter is thereafter evaporated and pressed out, etc., as at present but advantageously under insulated conditions.

The nitrocelluloses have been heretofore mixed or blended, in order to form so-called composite explosives, with sundry oxidizing agents such as nitrates of metallic bases; or with nitro-glycerins. It is important that such blends should be homogeneous and stable. When powders begin to decompose they lose their homogeneity and crumble—which means an end to regular pressure development when exploded, and which is all important especially for a propellant.

In some cases in order to attain a very thin liquid state, it is necessary to duly make an emulsion of the components, with the due addition and stirring therein of water, or more of a solvent than heretofore used; and which is subsequently after my said treatment, duly centrifuged or pressed out or e porated, or both.

Thus, ballistite, a gelatinized explosive containing nitroglycerin, is ordinarily prepared by pouring into warm water, a special kind of nitrocellulose, together with the necessary quantity of nitroglycerin, and stirring the resulting emulsion until the two components gelatinize; during the mixing and the early stirring before the final gelatinizing takes place, I add more solvent and apply my A. C. field.

Again, in the preparation of cordite, a solvent, usually acetone, of about four times the quantity, must be added to the mixture of nitrocellulose and nitro-glycerin; otherwise the highly nitrated cellulose used in cordite will not gelatinize with nitroglycerin alone.

Guncotton alone makes a very hard and somewhat brittle mass after treatment with the solvent and complete evaporation thereof; and small quantities of camphor, vaseline, castor oil and other substances are incorporated when suitably disssolved with the dissolved guncotton to moderate this hard state and for other purposes. All such I treat simultaneously advantageously in my electric induced alternating current fields before evaporating the solvent. It is understood that, as heretofore, all the smokeless powders, of which gelatinous guncottons or nitrated celluloses are the bases, are molded into some conveniently shaped grains, after evaporating most of the solvents.

Another application or illustration of the

application of my process is collodion cotton as used in the manufacture of gelatinized nitroglycerin; also in photography; and in surgery; and in making celluloid and artificial silk and for impregnating incandescent mantles. Collodion is a weakly nitrated cellulose usually regarded as a dinitrocellulose. The nitration is continued until a sample of the cotton when withdrawn, will dissolve in a mixture of two parts alcohol and one part ether. The temperature during nitration must remain low. The collodion is washed with cold water, then with boiling water; and is stabilized by treatment as described for guncotton with my A. C. electric process, *i. e.* while dissolved or in disperse state in said or other solvents, the solution is subjected to the A. C. fields preferably of low frequency, with a superimposed D. C. of about 1½% of the A. C.

Again, in the molding or drying of the explosives it is advantageous to conduct the same under insulated conditions but grounding free surplus negative alternations and charges through the interrupter adjusted accordingly.

Another illustration comprises the chlorate compound explosives such as have been heretofore prepared, consisting principally of potassium chlorate, intimately mixed with aromatic nitro compounds, and with the aid of vegetable or animal oils. The nitro-bodies which are adsorptive, are first dissolved in the oil, by warming it, and while still warm, the finely pulverized chlorate is mixed in, until the mixture becomes cool. After said dissolution and during the mixing, I advantageously apply my process, and thereby the nitro compounds are adsorbed by or with the chlorate compounds and the stability is increased and the sensitiveness of the explosive mixture is diminished; moreover, every chlorate compound particle has become coated thereby, by the electric adsorption, with a plastic oil, etc., covering, which modifies in a considerable degree the sensitiveness of the chlorate mixture to mechanical, chemical and thermal influences.

As an illustration of the application of my invention, I instance the following: In the well known displacement process for the nitration of cellulose, each pan ordinarily consists of a cylindrical stoneware vessel, constructed with a perforated stoneware removable false bottom; and below such is a pipe and cock for running off the liquid; when the charge of cotton has been entirely immersed in the mixture of nitrating acids in the vessel, a perforated stoneware top plate or cover, usually in 5 pieces, is placed thereon; means of flooding the top plates to a depth of about one inch with cold water are provided, in order to seal the nitrating acids and prevent fuming; my improvement provides that in the vessel, preferably insulated and preferably between the perforated upper and lower stoneware plates and parallel thereto, I place one or more sets of perforated insoluble plate electrodes with the nitrated cellulose therebetween and with means for providing an A. C. field between the electrodes under suitable control as to time or periods of application as well as voltage, amperage, frequency; and with means of intermittently electrically grounding the contents of the vessel through an exterior interrupter in an insulated ground leader wire from plate placed within the vessel and contents and in touch with the nitrating or wash liquids.

Subject to sundry variations in the above displacement process, ordinarily in the U. S. the nitration of the cotton requires about 15 minutes; and such is followed by continuation of the soaking for from 1 to 2½ hours; with means of keeping the temperature at about 30 to 32° C.; or 5 to 8° C. in another case; and thereafter the acids are drained off, the water is simultaneously poured into the vessel;—and flow of water continued therethrough about 45 minutes;—and finally the NC is removed to the wash house. I preferably use sealed or closed vessels to avoid introduction of or contact with air, but with ready means to gather and conduct away any gases. After the said first short period of about 15 minutes of nitration, I apply the A. C. field during said further soaking period or remainder of immersion period and likewise during the flow of water period; advantageously with intermittent ground connections through exterior interrupter for only the one kind of alternations or charges, advantageously the positive, synchronously with the A. C.

The foregoing describes the application of my improvement to one form of existing apparatus as used in the displacement process; but it will be understood that I do not limit myself to such alone.

It will be understood that my improvements also pertain not only to what is described as the displacement process of nitration, but likewise to other nitration processes, such as the direct dipping process; also the nitration of cotton by hand; also the nitration by centrifugals. That is to say, in all such nitration processes, I cause the nitration and nitrated product in disperse state to be passed through or acted upon by an A. C. field advantageously of low frequency, and narrow, between close electrodes or an induced field, at low temperature, under insulated conditions. Modifications of existing or other apparatus will readily be adapted. I do not restrict myself to any particular arrangement of electrodes; nor to a single set, but may use a multiple thereof.

It will be understood that in the blend-

ing of compound explosives, low temperatures are essential; such may be attained with ordinary cooling coils in the vessels or surrounding same or both.

The electrodes used should preferably be hollow and lined with insulating material and with circulating cooling liquids flowing therethrough, preferably such as are used in sundry electric furnaces.

I do not restrict my invention to the application of A. C. fields between electrodes; but also use induced A. C. fields, electromagnetic A. C. fields or others, from A. C. origin.

I may use either single phase or multiphase current, and the current may be applied either in series or in multiple. Wherever it is practicable to maintain insulated conditions, I advantageously use medium to high frequency A. C. In the making of compounds, in the blending and mixing as described,—it is advantageous to ground the positive free alternations or charges and to retain the negative, as such latter are conducive for the formation of the adsorption compounds.

A modification of the process as described consists in first dispersing or dissolving or thinning the components in suitable media or solvents such as acetone or ether-alcohol or other solvent, and thereafter conducting the blending or compounding of the components in the form of a spray or sprays injected into the A. C. fields, in said vessels across or as nearly perpendicular to the principal lines of force and under insulated conditions.

The process is also applicable in making sundry compounds known as intermediates such as anilin, salicylic acid, etc., and to transform benzol, toluol, napthalene, etc., and phenol anthracene and carbazol into the intermediates required for color production, etc.

I attain my improvements by the apparatus illustrated in diagram in the accompanying drawings, in which similar numbers and letters refer to similar parts.

Figures 1 and 5 and 6 are vertical sections of different types of dielectric vessels or chambers or spirals through which the liquids are passed and mixed and simultaneously electrically treated, advantageously by induced A. C. fields: Fig. 1 is of the well-known centrifugal basket type of vessel; Figs. 4 and 10 are perspectives of two other types of analogous vessels; Fig. 2 is a detail of horizontal section of line X, X, of Fig. 1 showing insulated transformer open core; Fig. 3 is a diagram of two A. C. circuits 50 and 60, shown in Fig. 4. Figs. 7 and 8 are vertical sections of interrupters in a ground line to ground only positive alternation or charges. Fig. 9 is a diagram of an interrupter adjustable to likewise ground only positive or only negative alternations or charges or ions.

Fig. 1 represents, in diagram, a vertical section of a type of well-known centrifugal or hydro-extractors, having open-top cylindrical vessel V, insulated, but I provide therein a centrifugal annular perforated basket or wringer 35,—37 a dielectric material or non-magnetic and insulated, with well-known means of rotating the basket about a spindle 33, revolved by a drive pulley and belting from below or above, under regulated speed, advantageously about 300 revolutions per minute, and having interior attemperating coils C, for cooling or heating to any desired temperature, with entrance pipe 31, and exit pipe 32, or the equivalent, for the entrance and final withdrawal of liquors to be treated; together with a system of piping and pump 70, in connection with pipe 31, to withdraw the liquor from lower part of vessel and pump to and return by suitable injector 63, to upper part of vessel, advantageously into the revolving basket, and thereby attain a continuous movement or circulation of the liquor through the vessel and its electric fields, in the liquids moving in space 5 and contents; such pump and piping and injector, or the equivalent, I also advantageously use with all other types of vessels V herein described, though not shown therein.

In all figures the letter H within the vessel V represents what I call a concentractor or leader plate or electrode-like plate or a mere conducting wire in the liquid, which must be neutral to the liquid, such as platinum or aluminum, or other good conductor, and insulated from the vessel, but electrically connected by an insulated leader wire to an exterior interrupter X such as Figs. 7 or 8 or 9, and making discharge connection therethrough for only the freed positive or negative alternation or charge gathered by the plate, and carried either to the ground or to a storage battery, advantageously through a Ruhmkorff coil after leaving the interrupter.

Z in Figs. 1 and 4 represents a grounding wire and system sometimes advantageous, from the insulated vessel V to ground, same advantageously through an interrupter like Figs. 7 or 8 permitting only the positive charge, if any, to pass to ground, and holding back the negative charges upon the insulated vessel and contents.

The revolving basket 35, advantageously insulated or of dielectric material, consists substantially of two concentric cylinders 35 and 37 with open tops, and with perforated sides, deep and narrow with solid plate 38 connecting bottom, and whereof the inner cylinder is sufficiently wide to permit the insertion from above of the insulated fixed-core

K, Fig. 1, (surrounded by a dielectric covering D) of an open-core transformer, whereof W is the primary coil, connected with the leads 50, from one phase of an exterior alternating current generator, Fig. 3, and without any wire secondary coil, the place and function thereof being taken by the moving liquid. The said core may also be described as an electro-magnet with bunched winding W. The magnetic reversals of the transformer core induce an A. C. stress within the liquid in the adjoining chamber; and such conflict with or oppose other induced A. C. stresses from the solenoid 35. In some cases, small paddles 39 are fixed upon the exterior of basket to aid in rapidly moving the liquids across the magnetic lines of force. C C are cooling or heating, *i. e.* attemperating piping, conveniently arranged on bottom or sides of the vessel, to cool or heat the liquid to an advantageous temperature, generally about 130° F.

An adjustable revolving winch is shown at 36, without details, having well known means for hoisting out said transformer W K, and thereafter attaching and hoisting out the centrifugal basket 35; and after dumping any solid contents from same, restoring the same by reverse operation. S, within the basket C, represents a fiber or comminuted solid adsorption material which may also be utilized therein, to purify the liquids and materials being treated as by removing colloids ordinarily not filterable and to attain improvements otherwise indicated herein.

No. 5 is a space or field between the fixed vessel V, and revolving basket 35, and also extending into the basket from the exterior inward; and 5 M is the space of field between the insulating cylinder D around the fixed-core K, and revolving basket 35, and extending into a basket from the interior outward, the stresses of the latter field conflicting with those of the former field in the liquid.

Surrounding the vessel V, is a solenoid coil 40, connected with the leads 60 of Fig. 3, of the other circuit from same two phase alternating current generator. Such solenoid creates an electromagnetic induced field within the vessel V and its liquid, when in operation and duly electrically connected; when the centrifugal is in operation the liquid is in rapid, circulation therein, cutting the lines of force more or less perpendicularly; and such field I call the solenoid induced field.

In lieu of one solenoid 40 of Fig. 1, I may also use two solenoids, duly shielded and insulated from each other, as shown in Fig. 5 at T and T from the two different currents 50 and 60; or with windings in opposite directions, *i. e.*, if one be wound clockwise—the other will be wound counter-clockwise; and the latter connected with a shunt circuit from the same circuit but preferably from the other current of the same two-phase alternator, and whereof one current leads to the said first solenoid. I also use a multiple of such two solenoids—with the alternately placed adjoining solenoids capable of being connected in multiple, to increase the induced magnetic field to allow any desired stress.

And the said transformer core K also sets up an induced alternating current field or stress, and which I call transformer induced field, in and adjoining 5 M, and the liquids moving therein; and the alternations thereof meet alternations more or less opposing from the solenoidal induced field; and with effects or results as regards adsorptions and charging of colloids and dispersoids, etc., as herein described or like those described, for alternating fields between electrodes in my aforesaid patents.

In lieu of said solenoid surrounding the vessel V, in some cases, I substitute a closed-core transformer or electromagnet like K″ W″ shown in Fig. 4, the core K being ring shaped or rectangular to inclose the vessel V.

Fig. #3 shows a wiring diagram of the alternating current circuits 50 and 60 from a two-phase alternating current generator; and circuit 50 leads to the primary coil W of the open-core transformer K of Figs. 1 or 6, the core K projecting into vessel V; and circuit 60 leads to the solenoids of Figs. 1 or 6 surrounding the vessel V.

By polyphase currents, I mean a system combining two or more alternating currents differing in phase angle, and advantageously symmetrical, and of flattened top wave, of maximum amplitude, with due means of control as to frequency, voltage and amperage; I use advantageously two A. C. from an alternator differing in phase angle by 180 degrees, and of equal amplitude and frequency or a multiple of such two A. C.

It is advantageous that the A. C. circuits be in a condition of resonance and that the circuits each contain inductance, resistance and capacity in series. An ammeter and rheostat (not shown) are placed in the A. C. circuits.

In some cases, advantageously when it is desired to remove sundry dispersoids and colloids from the liquid, by adsorption upon a solid comminuted adsorption material, I also utilize the centrifugal type apparatus like Fig. 1, by placing a comminuted or fibrous material S in the revolving basket 35 Fig. 1, advantageously packed in an annular wire container or series of containers or the like, against the inside of the basket frame, and which are made readily removable in whole or part and whereupon aggregated

colloids and dispersoids and precipitations are readily removed from the adsorbents in well known methods. For such purpose the supply of liquids is cut off and all liquid drawn from the centrifugal which is then, again set in motion to drain the adsorption material of most of its liquids, and thereafter the colloids, dispersoids or precipitants etc. are recovered and dried or treated as at present.

I do not restrict myself to the methods illustrated herein of attaining an alternating electric field through or with which the moving or agitated liquids are to be brought in contact. I may use any other methods of so doing which will readily suggest themselves to a skilled electrician; and including magnetic fields and electrostatic fields or the like, wherein alternating stresses are created, from A. C. sources as described.

Fig. 4 is an isometric projection in diagram, embodying in part one type of the apparatus of the invention for treating the liquids or liquid mixtures, or adaptable for other materials; it substantially comprises two parallelopipedons or box-like dielectric or insulated parallel vessels V and V′ placed one within the other, with narrow space or chamber 5 between same, to hold the material to be treated with a suitable liquid circulating therein; and advantageously through tube half-rings T T′ passing ring-like through the vessel and around one arm of each core; and means like 70 of Fig. 1, for withdrawing and returning or circulating the liquid to and from and through said space 5; and with well known means not shown for cooling or heating said liquid; and with means for creating one or more conflicting induced alternating electric fields, in space 5, by means of the closed cores of two transformers, to wit: one interior: W′ K′, and the others exterior: W″ K″, both without secondary wire coils;—the core K′ of the interior transformer, projecting into the vessel V′, and the core K″ of the exterior transformer surrounding the dielectric or insulated vessel V; the chamber for the passage and treatment of the liquids being between V and V′.

Fig. 4 also shows a wiring diagram of the above two alternating current circuits 50 and 60, leading respectively to the independent primary exciting coils W′ and W″, of the two independent transformers, of closed core type; the planes of the cores are practically perpendicular to each other, or placed so that the induced stresses or alternating current fields or alternations in the liquid solution, in vessel chamber 5, from the two transformers, will be in practical opposition, or in conflict.

Though Fig. 4 shows the vessels to be of rectangular horizontal section, yet, it will be understood, such may also be constructed round or of circular section.

The tube or semi-ring T of Fig. 4 is a diagram of a tube not fully shown passing over an arm of the transformer core K and projecting with open ends into the space or chamber 5, and so that liquids in chamber 5 will fill or circulate through T; and likewise the tube or semi-ring T′ not fully shown passes around or encircles one arm of the other transformer core K and projects with open ends into the same chamber 5 and so that the liquid therein will fill or circulate through T′ while *en route* through the vessel; and thereby the liquids will more efficiently act as the secondary coils of a transformer or will more readily take up the induced A. C. fields.

Fig. 5 is a diagram of part vertical section and part perspective of a dielectric or insulated tubular spiral coil, or chamber A or the like, of dielectric material such as gutta percha or glass, or pottery, and non magnetic; carrying the moving liquid and which is caused to move by the convolutions of the coil in a direction approximately perpendicular or across the induced A. C. lines of force, created by the solenoids T and T, surrounding a dielectric vessel V, inclosing the coil and holding a stagnant cooling liquid, but duly replaceable when heated, through pipes C; or the whole electric vessel may be set in a cooling oil.

Fig. 6 is a diagram of a part vertical section and a part perspective of a tubular dielectric worm or spiral chamber A, of dielectric and non-magnetic material and insulated, to carry a moving liquid approximately perpendicular or across the induced A. C. lines of force from the stationary solenoid T connected with A. C. circuit 60, around the dielectric container V holding a cooling stagnant liquid; or preferably set in a cooling vessel of oil; and further having the insulated core K of an open core transformer W K, projecting into the interior or hollow of the worm A, and having its primary wire coil connected with A. C. circuit 50 of different phase, there being no secondary wire coil; the solenoid and transformer creating conflicting induced A. C. fields within the spiral tube through which the liquids are forced under insulated condition.

Fig. 10 is a perspective view in diagram of an electric chamber or tube V passing through or surrounded by a revolving solenoid 85, consisting of an oblong helix of insulated conducting wire, wound lengthwise upon a drum 86, advantageously of dielectric material, and which is firmly affixed to a dielectric spool or bobbin 87, together revolving about the axis 101 of the hollow shaft or tube or conduit 88, being the cham-

bers carrying the liquid; advantageously cut away at 110, like an open gutter or conduit; and the drum being likewise cut away at center 104—105—106—107; and the bobbin being likewise cut away at the center 109—110; such cuts being arranged within the lines of the solenoid and to enable the induced lines of force 108 therefrom to more readily penetrate the liquid in the open conduit.

The solenoid is wound about the drum lengthwise, upon the principle of the armature of Siemens drum winding of a motor, or of a magneto generator and the like; the winding being in the plane equi-distant from and on both sides, of the center line 101 which is perpendicular to the axes of the solenoid; and about which center line, the solenoid and dielectric open drum and bobbin are caused to revolve as a single piece by well known means, such as a pulley and belt not shown.

Another such means is shown, with the bobbin 87 carrying at one end, outside of the solenoid, the ordinary slip rings 102 and 103 like an A. C. motor, against which there rub the ordinary brushes connected with a source or line 60 of A. C.; thereby the bobbin and solenoid will be duly revolved, synchronously with the armature of the A. C. generator.

Again the solenoid drum, bobbin and tube conduit, may be extended and placed like or to constitute the armature of a magneto-electric machine with its well known means of revolving the solenoid, in lieu of the regular armature, the conduit being stationary, thereby simultaneously generating the A. C. and revolving the solenoid creating the induced field in the liquid traversing the conduit.

The dielectric drum 86 and the bobbin 87 to which it is fixed, are advantageously not solid, but cut away on opposite sides to expose hollow spaces as for instance 104—105—106—107 and merely leaving a cylindrical skeleton of connecting staves, 104—105 and 106—107 to connect the tubular ends; through such hollows, the magnetic lines of force 108 of the solenoid, pass with less obstruction or interference, to the contents of the conduit 88, which though generally a closed dielectric tube, especially when filled with a comminuted solid adsorption material, yet without the latter may in some case be advantageously, an open dielectric trough 110 carrying the liquid, and which need not be forced or transported rapidly, but may pass slowly through the open conduit, as the electromagnetic lines of force, due to the revolving solenoid, move most rapidly across the direction of the line of movement of the liquid, which thereupon takes up the A. C. by induction. A few turns only of the solenoid are shown for facility of illustration; many more such being advantageously used constituting a bunched coil. At H is indicated the ground electrode plate or wires with a lead to earth through an interrupter or valve X not shown.

Figs. 7 and 8 are diagrams of interrupters or discharge valves X—in series in the discharge wire, from the concentrator or leader plate H and over which the liquids flow in the electric chamber; and which interrupters permit only positive charges to pass or discharge to earth or a storage battery; and generally in amount to balance the negative charges taken up from aforesaid A. C. fields, by the colloids or dispersoids, in disperse state to form the compounds in the liquids.

Fig. 9 is a diagram of an analogous but adjustable interrupter or discharge valve X, adjustable to pass or discharge either only positive or only negative charges from the liquids while moving through the insulated A. C. fields; such discharges being in synchronism with the frequency of the A. C. circuit used to create the A. C. field within the electric vessel and its liquids.

Fig. 7 is a diagram of vertical section of such positive interrupter comprising a simple cell of the electrolytic rectifier type, consisting advantageously of a single battery-jar 70, and with cathode 71 of aluminum or aluminum alloy, and anode 72, much larger, of lead or polished steel; and with electrolyte neutral solution in the jar of ammonium phosphate. The whole jar is placed in a cooling oil or liquid in a surrounding container 77, to keep the temperature low, advantageous about 86° F., and not above 122° F. In the operation of my process, I connect the anode 72 in such valve, with the wire 73 from plate H in the chamber over which the liquid flows, and I connect the said cathode 71 to a storage battery or to earth through wire 74 either direct, or advantageously through a condenser (as shown at 75—76, of Fig. 8) whose negative plate 76 is earthed and whose positive plate 75 is connected with 74 the line from interrupter.

Thereby only positive charges pass to earth or first to a Ruhmkorff coil and thence intermittently to earth. The plate H first condenses or gathers the positive charges freed in the liquid to counterbalance the negative charges conveyed through ions and taken up by the colloids or dispersoids; and from H such readily pass to the far larger condenser plates 75. The plate H acts like a cathode, and the colloids or dispersoids and the like,—analogous to a corresponding or balancing anode.

Fig. 8 is a diagram and part vertical section of another positive discharge valve or interrupter X in the discharge line, 73 from the plate H in the liquid, and comprising a tube 80 filled with ionized mercury vapor,—the air having been duly exhausted there-

from and having therein a single metal plate 82, such as iron for an anode, and mercury 81 in bottom cup of tube as the cathode terminal; the general construction being like the mercury vapor rectifier. The operation is like that above explained for Fig. 7. Such positive valves are used advantageously where the principal colloids and dispersoids in the liquid being treated are electronegative.

In some cases especially where the dispersoid content of the liquid is large, and the vessel a long one, I use two independent but similar leader plates, H, placed far apart, as in Fig. 5, H and H, and each having its independent discharge line and interrupter.

Fig. 9 is a diagram of an adjustable discharge valve or interrupter X in the line 100 from plate H in the liquid in the alternating field,—the interrupter being adjustable to pass only either positive or negative charges and in synchronism with the frequency of the A. C. which creates said A. C. field.

The drawing shows the diagrammatic adjustment to pass only positive charges. In said figure, No. 91 represents a vibrating contact tongue, or vibrator or rocker or the like, of an instrument such as a polarized electromagnet or other "relay," 90, or a "sounder," or the double contact rocker of an electro-magnetic rectifier or the like; and actuating same, is the A. C. line 50, a shunt from the A. C. which creates the A. C. field in or by which the liquid is treated. Toward the free vibrating end of 91, separated therefrom by insulators, and on opposite sides thereof, there are placed two contact points or plugs 94 and 95, the former being termed positive and latter negative, and which are so fixed as to make contact with, and close a gap or plug orifice in the discharge line 100 H, at 94 when the vibrator 91 is attracted at 96 by the electro-magnet of 90, due to positive pulsations of the A. C. 50.

At 98 and 99 are positive and negative adjustment set screws supported by fixed sleeves or supports, 92 and 93 respectively; the line 100, after leaving or beyond the contacts 94 or 95, is permanently adjustable or switched to 98 or 99 for discharging or grounding only positive or only negative charges respectively; at 89 is a diagram of a hinge in line 100 about which the center line 100 is turned or withdrawn by set screw 99, which is unscrewed accordingly, until socket 95′, of line 100 is entirely out of reach of contact 95 of vibrator, when the vibrator reaches its maximum negative swing, and thus there is never any contact at 95 when positive charges are passed therethrough to a storage battery or to earth at 77, either direct or through a Ruhmkorff coil 75 or a closed core transformer with the secondary wire thereof leading to earth.

When it is desired to earth only negative alternations or waves from H, and its ground line 100 H′, the permanent adjustment is first made by unscrewing 98, and closing screw 99, until there is contact between 95 and the vibrator, when the vibrator is attracted at 97 by the negative pulsations; and thereupon contact 95 closes electrical connection of line 100 H′ to line from screw 99 and thence to earth.

In order to accelerate the grounding as at 77, I in some cases place in the ground line 100 an apparatus like a Ruhmkorff coil or a closed-core transformer 75 and 76, the line 100 constituting the primary wire thereof 75, and the secondary wire thereof 76 with higher voltage being the ground wire, the higher voltage insuring the grounding.

I do not restrict myself to the interrupters described, but may use other current-passing interrupters or valves, where only one pulsation or charge or alternation of the the A. C. passes therethrough.

It is advantageous with nitrates and the like to insure complete protection against electrolytic action in an A. C. field or from an A. C., of low frequency, to superimpose upon the A. C. in the liquid a direct current of about one and a half per cent. of the A. C.

It is advantageous where electrodes are used, to make such of a catalytic metal, as of nickel or cobalt or platinum.

My process avoids agitating or shaking machinery or mechanical agitation in mixing composite explosives or other compounds of an explosive nature; and avoids the present long period or long standing to attain reactions,—by dissolving or dispersing in suitable media the sundry components, and mixing and blending such in narrow A. C. fields in suitable narrow vessels or tubes or between electrodes close together.

I claim:

1. A process of electric treatment in the manufacture of loose compounds including explosives, nitro substitution products, composite nitro explosives, nitro-celluloses and the like, which comprises dissolving, and dispersing the components of the compounds in suitable liquid mobile media, and blending and mixing the solutions in an alternating current field or fields of regulable frequency and strength, under suitable temperature and speed and time period, and under insulated conditions.

2. A process of electric treatment in the manufacture of loose compounds including explosives, nitro substitution products, composite nitro explosives, nitro-celluloses and the like, which comprises dissolving, and dispersing the components of the compounds

in suitable liquid mobile media, and blending and mixing the solutions in an alternating current field or fields, of regulable frequency and strength, under suitable temperature and speed and time period, and under insulated conditions, and with intermittent ground connections from the solutions through an interrupter passing only unbalanced charges therefrom to earth.

3. A process of electric treatment in the manufacture of loose compounds including explosives, nitro substitution products, composite nitro explosives, nitro-celluloses and the like, which comprises dissolving, and dispersing the components of the compounds in suitable liquid mobile media, and blending and mixing the solutions in alternating current fields from A. C. sources of regulable like frequency and strength, under suitable temperature and speed and time period, and under insulated conditions; and with intermittent ground connections, from the liquids passing only free unbalanced positive charges to earth, in synchronism with the frequency of an A. C. creating one of said fields.

4. A process of electric treatment in the manufacture of loose compounds including explosives, nitro substitution products, composite nitro explosives, nitro-celluloses and the like, which comprises dissolving, and dispersing the components of the compounds in suitable liquid mobile media, and blending and mixing the solutions in an alternating current field or fields from A. C. sources of regulable frequency and strength, under suitable temperature and speed and time period, and under insulated conditions; and with intermittent ground connections from the liquids passing only free unbalanced negative charges to earth, in synchronism with the frequency of an A. C. creating one of said fields.

5. A process of electric treatment in the manufacture of loose compounds including explosives, nitro substitution products, composite nitro explosives, nitro-celluloses and the like, which comprises dissolving, and dispersing the components of the compounds in suitable liquid mobile media, and blending and mixing the solutions in an alternating current field or fields from A. C. sources of regulable frequency and strength, under suitable temperature and speed and time period, and under insulated conditions, and with intermittent ground connections from the solutions through an interrupter passing only unbalanced charges therefrom to earth; the said A. C. fields being duly created between suitable electrode terminals between which the solutions are duly rapidly brought in contact.

6. A process of electric treatment in the manufacture of loose compounds including explosives, nitro substitution products, composite nitro explosives, nitro-celluloses and the like, which comprises dissolving, and dispersing the components of the compounds in suitable liquid mobile media, and blending and mixing the solutions in an alternating current field or fields, from A. C. sources of regulable frequency and strength, under suitable temperature and speed and time period, and under insulated conditions, and with intermittent ground connections from the solutions through an interrupter passing only unbalanced charges therefrom to earth, the said A. C. fields being duly created by induction.

7. A process of electric treatment in the making of loose compounds including explosives, which comprises dissolving and dispersing the components in suitable thin liquid mobile media and blending the solutions and, subjecting the same under regulated temperature, pressure and time period and under insulated conditions, in simultaneous opposing conflicting stresses in the blended liquids from and of several A. C. fields, from A. C. sources of regulable frequency voltage and amperage, and with a superimposed D. C. in the liquids, of about 1½ % of the strength of the A. C.

8. A process of electric treatment in the making of loose compounds including explosives, which comprises dissolving and dispersing the components in suitable thin liquid mobile media and blending the solutions and, subjecting the same under regulated temperature, pressure and time period and under insulated conditions, in simultaneous opposing conflicting stresses in the blended liquids from and of several A. C. fields; from A. C. sources of regulable frequency and strength, and with intermittent ground connections from the blended solution, passing only free unbalanced positive charges to earth in synchronism with the frequency of an A. C. creating one of said fields.

9. A process of electric treatment in the making of loose compounds including explosives, which comprises dissolving and dispersing the components in suitable thin liquid mobile media and blending the solutions and, subjecting the same under regulated temperature, pressure and time period and under insulated conditions, in simultaneous opposing conflicting stresses in the blended liquids from and of several A. C. fields; and with intermittent ground connections from the blended solution, passing only free unbalanced negative charges to earth in synchronism with an A. C. creating one of said fields.

10. A process of electric treatment in the making of nitro-explosives embodying nitrocellulose which comprises changing the

state of nitro-cellulose before it is colloided and solidified, by dissolving same in a suitable solvent to a very thin consistency, and then blending same with the other ingredients dissolved and dispersed and thinned in suitable solvents, the said blending being conducted in an A. C. field from A. C. source of regulable frequency and strength under insulated conditions at low temperature, and with a superimposed D. C. in the liquid of about 1½ % of the A. C.

11. A process of electric treatment in the making of nitro-explosives embodying nitrocellulose which comprises changing the state of nitro-cellulose before it is colloided and solidified, by dissolving same in a suitable solvent to a very thin consistency, and then blending same with the other ingredients dissolved and dispersed and thinned in suitable solvents, the said blending being conducted in an A. C. field, under insulated conditions at low temperature, and with intermittent ground connections from the blended solution, passing only free unbalanced positive charges to earth in synchronism with the frequency of an A. C. creating one of said fields.

12. A process of electric treatment in the making of nitro-explosives embodying nitrocellulose which comprises changing the state of nitro-cellulose before it is colloided and solidified, by dissolving same in a suitable solvent to a very thin consistency, and then blending same with the other ingredients dissolved and dispersed and thinned in suitable solvents, the said blending being conducted in A. C. fields, under insulated conditions at low temperature, and with intermittent ground connections from the blended solution, passing only free unbalanced negative charges to earth in synchronism with the frequency of an A. C. creating one of said fields.

13. A process of electric treatment in the making of loose compounds including explosives, which comprises dissolving and dispersing the components in suitable thin liquid mobile media and blending the solutions and subjecting the same under regulated temperature, pressure and time period and under insulated conditions, in simultaneous opposing conflicting stresses in the blended liquids from and of several A. C. fields, the said A. C. fields being created from A. C. electromagnetic source of regulable frequency and strength.

14. A process of electric treatment in the making of loose compounds including explosives, which comprises dissolving and dispersing the components in suitable thin liquid mobile media and blending the solutions and subjecting the same under regulated temperature, pressure and time period and under insulated conditions, in simultaneous opposing conflicting stresses in the blended liquids from and of several A. C. fields, all of like frequency and strength, the said A. C. fields being created from A. C. electromagnetic source, and having intermittent ground connections from the blended liquids, passing only free unbalanced positive charges to earth in synchronism with the frequency of the A. C. creating one of said electromagnetic fields.

15. A process of electric treatment in the making of loose compounds including explosives, which comprises dissolving and dispersing the components in suitable thin liquid mobile media and blending the solutions and, subjecting the same under regulated temperature, pressure and time period and under insulated conditions, in simultaneous opposing conflicting stresses in the blended liquids from and of several A. C. fields, of like frequency; the said A. C. fields being created from A. C. electromagnetic source, and having intermittent ground connections from the blended liquids passing only free unbalanced negative charges to earth in synchronism with the A. C. creating one of said electromagnetic fields.

16. A process of electric treatment in the making of loose compounds including explosives, which comprises dissolving and dispersing the components in suitable thin liquid mobile media and blending the solutions and, subjecting the same under regulated temperature, pressure and time period and under insulated conditions, in simultaneously opposing conflicting stresses in the blended liquids from and of several A. C. fields, of like frequency and strength; the said A. C. fields being created electrostatically from A. C. sources, of regulable frequency and strength.

17. A process of electric treatment in the manufacture of loose compounds including explosives, nitro substitution products, composite nitro explosives, nitro-celluloses and the like, which comprises dissolving, and dispersing the components of the compounds in suitable liquid mobile media, and blending and mixing the solutions in an alternating current field or fields under suitable temperature and speed and time period, and from like A. C. sources of regulable frequency and strength, under insulated conditions; the solutions being connected to earth through an insulated interrupter making earth connection in synchronism with the frequency of only one of the alternations of each cycle of one of the alternating currents, the interrupter being in one lead of such circuit, and balanced by an impedance coil in the other lead thereof.

18. A process of electric treatment in the manufacture of loose compounds including explosives, nitro substitution products, com-

posite nitro explosives, nitro-celluloses and the like, which comprises dissolving, and dispersing the components of the compounds in suitable liquid mobile media, and blending and mixing the dispersed liquids and solutions in an alternating current field or fields under suitable temperature and speed and time period, and under insulated conditions, and with intermittent ground connections from the liquids through an interrupter passing only unbalanced charges therefrom to earth, the solutions being previously duly changed to an acid state.

19. A process of electric treatment in the manufacture of loose compounds including explosives, nitro substitution products, composite nitro explosives, nitro-celluloses and the like, which comprises dissolving, and dispersing the components of the compounds in suitable liquid mobile media, and blending and mixing the solutions in an alternating current field under suitable temperature and speed and time period, and under insulated conditions, and with intermittent ground connections from the solutions through an interrupter passing only unbalanced charges therefrom to earth, the solutions being previously changed to a basic state.

20. A process of electric treatment in the manufacture of loose compounds including explosives, nitro substitution products, composite nitro explosives, nitro-celluloses and the like, which comprises dissolving, and dispersing the components of the compounds in suitable liquid mobile media, and blending and mixing the solutions in alternating current fields, from like A. C. sources of regulable frequency and strength, under suitable temperature and speed and time period, and under insulated conditions, and with intermittent ground connections from the solutions through an interrupter passing only unbalanced charges therefrom to earth, the blended solution having been previously duly changed to an acid state; and after said treatment and passage duly changing the solution to a basic state and again subjecting same to a like passage and electric treatment.

21. A process of electric treatment in the manufacture of "loose" compounds including explosives, which comprises dissolving and dispersing the components in suitable liquid mobile media, in an A. C. field with a superimposed D .C., and then blending and mixing the solutions in an alternating current field from an A. C. source of regulable frequency and strength, under suitable temperature and speed and time period and under insulated conditions.

22. A process of electric treatment in the making of loose compounds including explosives which comprises dissolving and dispersing the components in suitable thin liquid mobile media and blending the solutions and, subjecting the same under regulated temperature, pressure and time period, first in a field of A. C. stresses from a single phase source, followed by like treatment from a polyphase system, all under insulated conditions.

23. A process of electric treatment in the making of loose compounds including explosives, which comprises dissolving and dispersing the components in suitable thin liquid mobile media and blending the solutions and, subjecting the same under regulated temperature, pressure and time period, first in a field of A. C. stresses from a single phase source, followed by like treatment from a polyphase system of regulable frequency and strength, all under insulated conditions; and with intermittent ground connections from the blended solution, passing only free unbalanced charges to earth in synchronism with the freqeunecy of an A. C. creating one of said fields.

24. A process of electric treatment in the making of loose compounds including explosives which comprises dissolving and dispersing the components in suitable thin liquid mobile media and blending the solutions and, subjecting the same under regulated temperature, pressure and time period, first in a field of A. C. stresses from a single phase source followed by like treatment from a polyphase system, all of like and regulable frequency and strength under insulated conditions; and with intermittent ground connections from the blended solution, passing only free unbalanced negative charges to earth in synchronism with an A. C. creating one of said fields.

25. A product of so-called "loose" compounds, including composite explosives, having electrically fixed, stable, dense molecular structure in non-strained equilibrium.

26. A product of so-called "loose" compounds, including composite explosives, having electrically fixed, stable, dense molecular structure in non-strained equilibrium and including electrically adsorbed dispersoids and particles of increased true specific gravity and homogeneity, and substantially free from gases, vapors and substances of loose molecular structure and compounds in strained equilibrium.

27. A new product comprising explosives and molecules and compounds heretofore known as "loose" compounds, having electrically adsorbed molecular structure of increased density and true specific gravity and homogeneity, and comprising electrically adsorbed suspensoid colloids, and without components resulting in corroding impurities when exploded.

28. A new product comprising explosives

and molecules and compounds heretofore known as "loose" compounds, having electrically adsorbed molecular structure of increased density and true specific gravity and homogeneity, and comprising electrically and homogeneously adsorbed suspensoid colloids; and free from amphoteric dispersoids and particles of loose molecular structure, and in strained equilibrium.

29. A new manufacture, in the making of "loose" compounds including explosives, consisting of substances comprising dispersoids and compounds in solid state, ordinarily, of loose molecular structure and strained equilibrium, and electrically transformed into a substance of same molecular groups of less sensitiveness, of firmer, and more stable molecular structure, and in non-strained equilibrium.

30. As a new manufacture, a nitrosubstitution compound, having electrically adsorbed molecules, including nitrogen compounds, of increased true specific gravity and homogeneity, in non-strained equilibrium, and substantially free from gases, and substances of loose molecular structure and compounds in strained equilibrium.

31. A composite explosive, comprising electrically adsorbed nitrosubstitution compounds of enhanced true specific gravity, electrically compounded and compacted with other components while in disperse state, free from hydrated impurities, gases, and particles of loose molecular structure.

32. An explosive comprising nitrocelluloses of different percentages of nitrogen content electrically adsorbed and compacted together in stable equilibrium and freed from "loose" molecular structures.

33. An explosive comprising nitrocelluloses of different percentages of nitrogen content electrically adsorbed and compacted together in stable equilibrium and freed from "loose" molecular structures; and electrically compacted with other components of composite explosives.

34. A nitro-colloid in combination with a uniformly adsorbed oxygen carrier throughout its mass.

35. An apparatus of the nature described, comprising a dielectric narrow chamber between two insulated parallel vessels, in combination with means of passing liquids into and through said chamber; means for maintaining in said liquids while in said chamber, conflicting induced fluctuating stresses under insulated conditions from magnetic reversals of independent transformer cores without secondary coils, the primary coils carrying A. C. of regulable frequency and strength and different phases.

36. An apparatus of the nature described, comprising a dielectric chamber between two insulated parallel vessels; insulated means for intermittently passing into and out of said chamber and of blending and mixing in said chamber, suitable liquids containing in thin disperse state means for simultaneously creating in said liquids in said chamber conflicting alternating stresses, induced therein by two closed-core transformers without secondary coils, the one transformer having its core surrounding the exterior of the outer of said vessels, and excited by a primary exciting coil from one A. C. circuit; and the other transformer having its core projecting into and within the inner of said two vessels and being excited by a primary exciting coil from another A. C. circuit of like suitable regulable frequency, and strength and differing in phase from the former current; all under insulated conditions; with means for intermittent electric discharge from the said liquid through an interrupter for the freed surplus charges only.

37. An apparatus of the nature described, comprising a dielectric chamber between two insulated parallel vessels; insulated means for passing into said chamber across the lines of force of an A. C. field therein and of blending and mixing in and withdrawing from said chamber a suitable liquid compound; means for simultaneously creating in said liquids in said chamber conflicting fluctuating alternating stresses, induced therein by two sources; the one source being the core of an electromagnet projecting into and within the inner of said two vessels and being excited by a primary coil from one A. C. circuit and another source being a solenoid surrounding the outside of the outer of said two vessels, the solenoid being excited from another A. C. circuit of like suitable frequency and equal magnitude and differing in phase from the former A. C. circuit; all under insulated conditions with means for intermittent electric discharge from the said liquid through an interrupter for the freed surplus charges.

38. An apparatus of the nature described comprising an insulated chamber between insulated parallel cylindrical vessels; the said chamber having a centrifugal perforated revolving plate basket between said vessels with means of revolving the basket at regulated speed about a common axial line; insulated means for intermittently passing into and out of said chamber and basket and of blending and mixing in said chamber and basket suitable liquid compounds and adsorbents; means for simultaneously creating in said chamber and centrifugal plate basket and in said liquids, induced conflicting alternating stresses from two fields, whereof one field is induced therein by and through the core of an insulated electro magnet with bunched winding having its core insulated

and projecting into and within the inner of said two vessels and being excited by a primary bunched wire solenoid coil from one A. C. circuit, and a second field induced through an exciting solenoid surrounding the outside of the outer of said two vessels, the solenoid being excited from another A. C. circuit of like suitable frequency and voltage and amperage and with suitable difference in phase; and means of removal, unloading and reloading and replacing said centrifugal basket and contents means of washing and saturating the contents of said basket, in place, centrifugally with suitable liquids.

39. An apparatus of the nature described, comprising the combination of a dielectric chamber; with means for forcibly injecting into and against the walls of said chamber, and of withdrawing and repeating the injection of a liquid mixture means for simultaneously creating in said chamber and mixture induced conflicting alternating fields duly induced by separate A. C. circuits differing in phase, all under insulated conditions; with means for intermittent ground electric connections from said mixture, making earth connection, through an interrupter with the positive alternation of one of said A. C. circuits.

40. An apparatus of the nature described comprising an insulated non magnetic worm within a cylindrical tube with means for passing into and out of the worm under insulated conditions at regulated temperature, pressure and velocity, suitable liquid compounds and mixtures with means for simultaneously creating in the liquid therein through insulated suitable separate exciting A. C. solenoids, around the tube induced conflicting alternating stresses, the said solenoids being excited by separate A. C. circuits of a polyphase system of regulable frequency voltage and amperage; with means of attemperating the liquid while in said worm, under insulated conditions.

41. An apparatus of the nature described comprising a fixed insulated conduit tube, constituting the center of and surrounded by a revolving long solenoid of uniformly distributed winding; means of revolving the solenoid about the tube as a center; means of simultaneously exciting the solenoid with an A. C. of suitable regulable frequency, voltage and amperage; means of simultaneously passing liquids through said tube while the solenoid is revolving about same, under insulated condition.

42. In an apparatus of the nature described a set of two revolving insulated roller electrodes having exterior surface. plate electrodes constituting terminals of two independent A. C. circuits, the anode of one alternating current circuit opposite and parallel to a like anode of another alternating current circuit, with cathode practically insulated by distance from anode, with means for changing and adjusting the distance between the electrodes with means for passing liquid blends between the said opposing electrodes of different sets of electrodes under insulated condition, with means for revolving the roller electrodes.

43. In an apparatus of the nature described, sets of revolving electrodes having anodes facing and close to each other in a suitable liquid, and connected with the terminals of separate alternating current circuits, the anode of one circuit facing the anode constituting a terminal of another A. C. circuit, with the cathode of the latter adjoining the anode of the former and insulated therefrom, with means for moving a fiber material through said liquid, between the like electrodes of said A. C. circuits of regulable frequency and strength under insulated conditions.

44. In an apparatus of the nature described a set of two revolving electrode rollers having exterior plate electrodes those upon one roller constituting the anode of one alternating current circuit, opposite and parallel to a like anode upon the other roller of another alternating current circuit, from a common two-phase alternating current generator, with means for changing and adjusting the distances therebetween, with means for passing fibrous material between the said anodes immersed in a suitable liquid.

45. In an apparatus of the nature described, an insulated roller electrode, with detachable insulated plate electrodes connected with and forming the circumference of the roller, having interior attemperating circulating medium, with revolving agitator fans centered on the axis of the roller, and with means for revolving the said roller.

46. In an apparatus of the nature described an insulated electric discharge line projecting into and from a suitable insulated vessel, containing and through which is passing, a suitable insulated liquid excited by sundry A. C. in combination with an exterior adjustable insulated interrupter in said line, adjusted to pass and suitably discharge to earth, the freed surplus alternating charges of one sign only, from said liquid, under insulated conditions, and in synchronism with the alternations of one of said A. C. of like sign.

47. In an apparatus of the nature described, an insulated electric discharge line conductor wire projecting into and from a suitable liquid passing through a suitable dielectric vessel, the liquid being simultaneously excited by sundry alternating currents, in combination with an exterior ad-

justable insulated interrupter in said line comprising the vibrator of an A. C. relay, having contact terminals closing the discharge circuit in synchronism only with the one kind of alternations of the A. C. of the relay, the said A. C. being one of the currents exciting the said liquid.

48. A composite explosive comprising electro-negative adsorption compounds of enhanced stability.

49. A composite explosive comprising electro-negative compounds of enhanced density and stability.

50. A composite explosive having electro-negative compounds comprising elements of explosives.

51. A composite explosive having electro-negative group compounds comprising necessary elements of explosives.

52. A nitrogen explosive comprising electro-negative compounds having as components, the nitrogen and other elements essential for explosion.

53. A nitrogen explosive compound having its nitrogen and other explosive elements in the form of electro-negative groups.

Signed at Newark, in the county of Essex and State of New Jersey, this 16th day of November, A D. 1917.

JACOB E. BLOOM.

Witnesses:
VICTOR R. LEVY,
ELMER H. BUECHELE.