No. 692,631. Patented Feb. 4, 1902.

J. F. COOLEY.

APPARATUS FOR ELECTRICALLY DISPERSING FLUIDS.

(Application filed Oct. 6, 1899. Renewed June 8, 1900.)

(No Model.) 2 Sheets—Sheet 1.

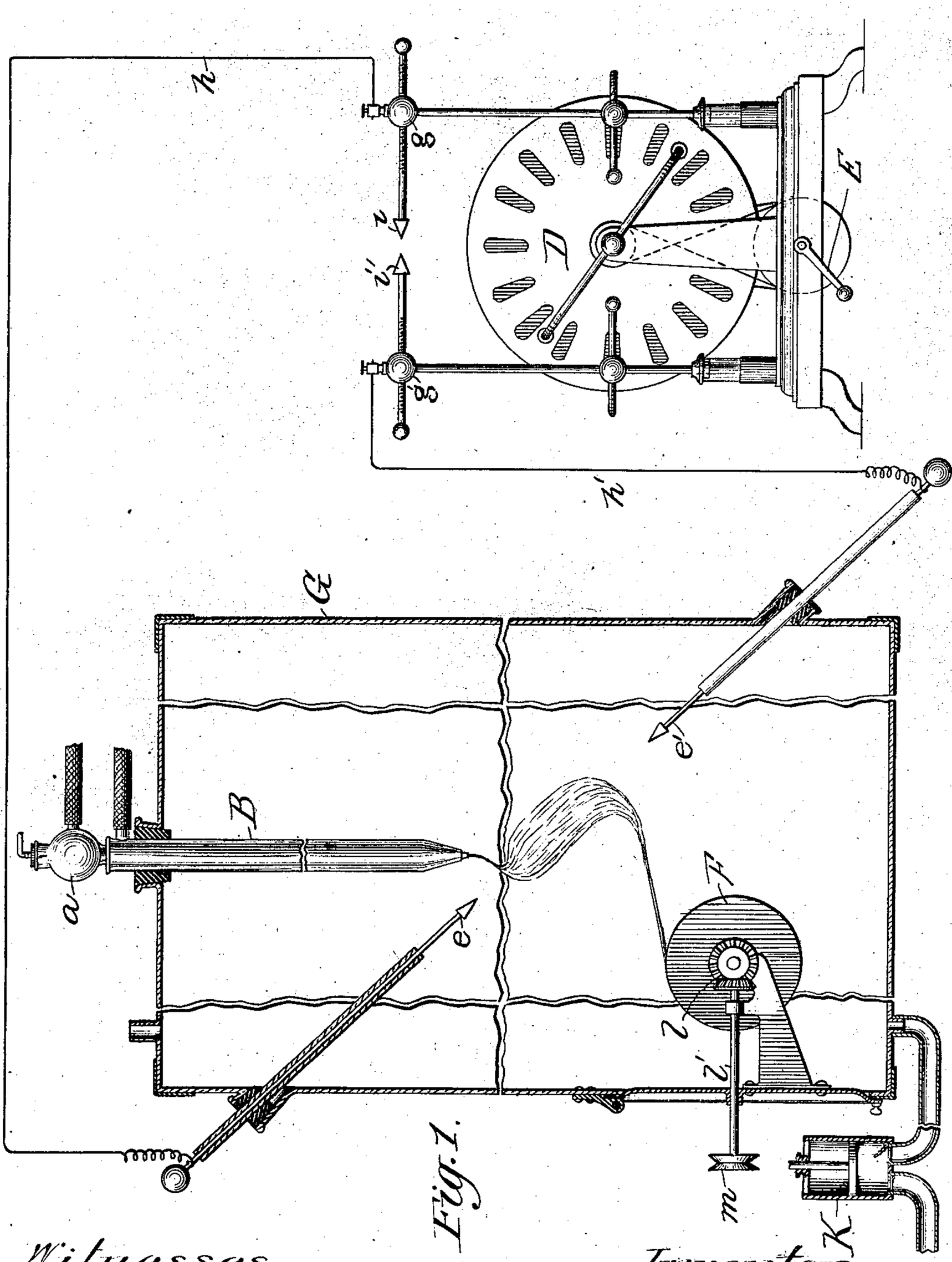

Fig. 1.

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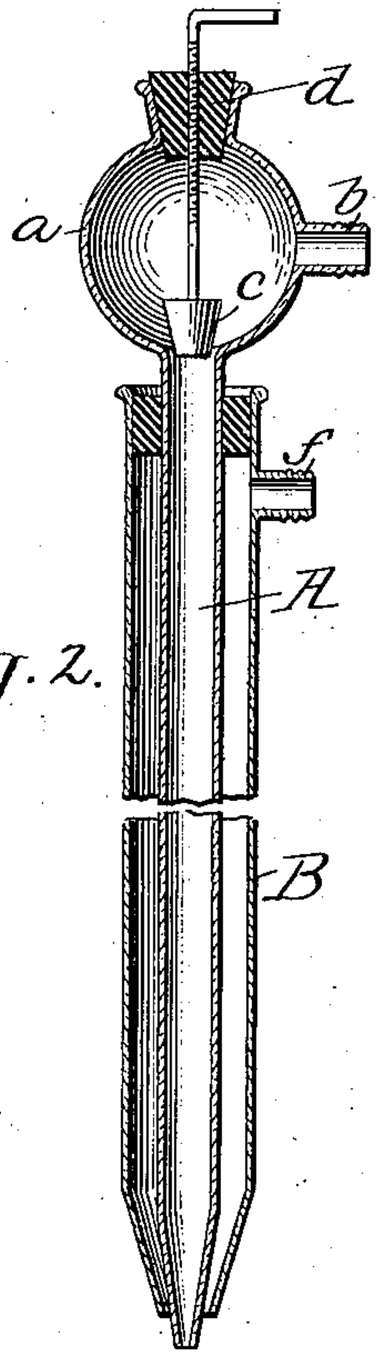


Fig. 2.

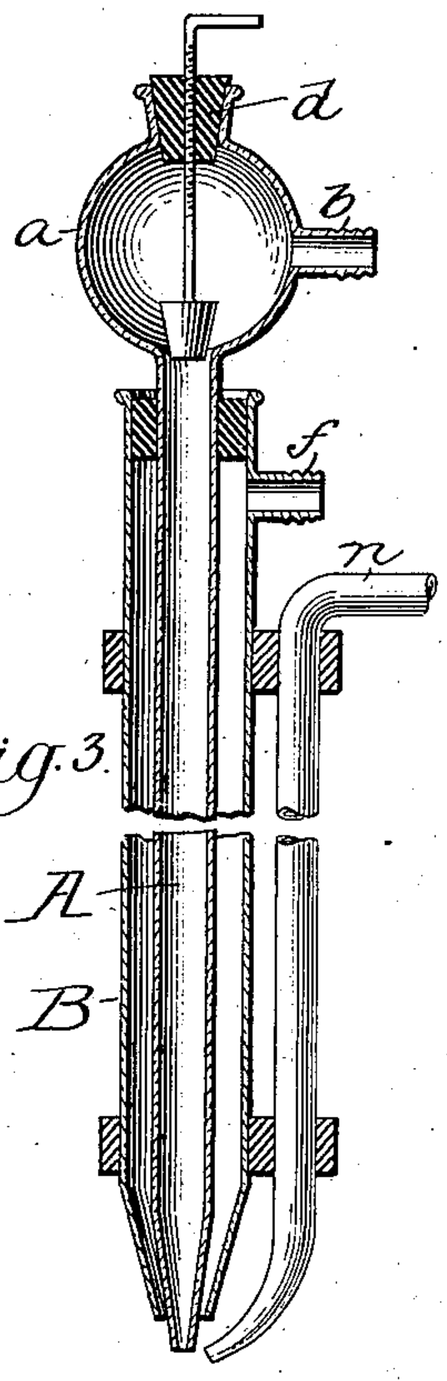


Fig. 3.

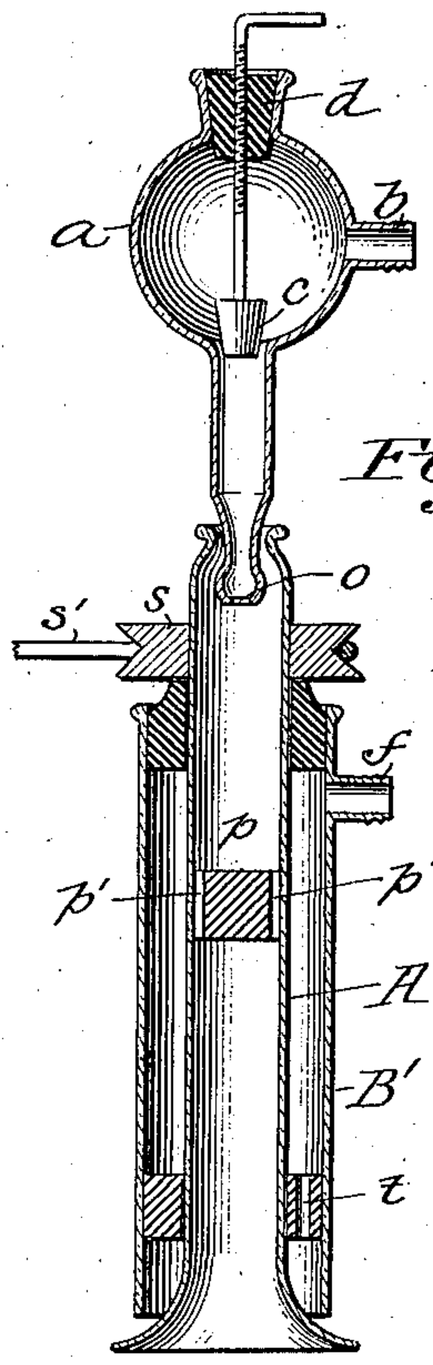


Fig. 4.

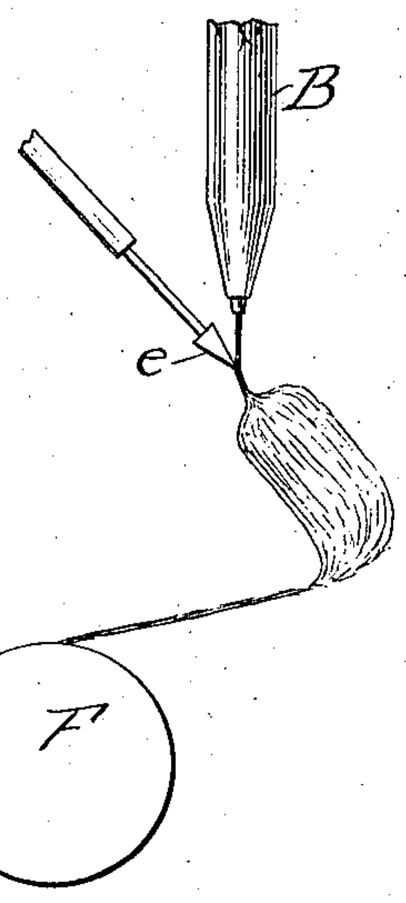
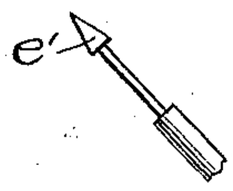


Fig. 5.



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APPARATUS FOR ELECTRICALLY DISPERSING FLUIDS.

SPECIFICATION forming part of Letters Patent No. 692,631, dated February 4, 1902.

Application filed October 6, 1899. Renewed June 8, 1900. Serial No. 19,625. (No model.)

To all whom it may concern:

Be it known that I, JOHN F. COOLEY, a citizen of the United States, residing at the city of Boston, county of Suffolk, State of Massachusetts, have invented certain new and useful Improvements in Apparatus for Electrically Dispersing Fluids; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

This my invention relates to an apparatus for electrically dispersing fluids.

In a companion application of even date herewith, Serial No. 732,798, I have described and claimed certain new and useful improvements in method of electrically dispersing fluids by subjecting the fluids in a free and attenuated formation to the disruptive and dispersive action of a gaseous field of convective action of electricity at high tension. The present invention relates to apparatus for carrying out said methods.

In the accompanying drawings, Figure 1 represents, partly in section and partly in elevation, one form of apparatus embodying my invention. Fig. 2 represents on a larger scale and in section the delivering device shown in Fig. 1. Fig. 3 represents a like view of a modified form of the delivering device. Fig. 4 represents a like view of a further modification thereof. Fig. 5 represents a like view to that shown in Fig. 1 of the collecting-reel, delivering device, and convective-field electrodes, the said delivering device and electrodes having a different relative position with respect to each other.

Referring to Figs. 1 and 2 of the drawings, A indicates a tube made of glass or other substance, which tube terminates at its lower end in a small nozzle, which serves as a means for delivering the fluid in a free and attenuated streaming formation into the path of convective action. The tube terminates at its upper end in an enlargement or bulb *a*, which, together with the inlet-tube *b*, serves to supply the fluid to the tube A. In order to regulate the quantity of fluid supplied to the delivery-tube A, the bulb *a* may conveniently be provided with a conical valve or plug *c*, having a screw-threaded stem passing through a stopper *d*, so that by raising or lowering the plug *c* the area of the opening governed by said plug may be correspondingly varied. The inlet-tube *b* admits the fluid to be treated under sufficient pressure to insure its delivery from the open end of the tube A in such manner as to cause it to issue in a free and attenuated streaming form into the convective field either at a short distance from one of the electrodes, as indicated in Fig. 1, or in any intermediate position between both electrodes or in immediate or substantially immediate contact with said electrode, as indicated in Fig. 5. For the purpose of supplying a supplementary fluid to the verge of the outlet of the tube A, I may surround the tube A with an inclosing tube B and make the outlet end of the tube A (and preferably also the outlet end of the inclosing tube B) conical, so that by sliding the one longitudinally upon the other the area of the annular opening between their outlet ends may be correspondingly adjusted or regulated. Into the space between the two tubes I introduce the supplementary fluid, preferably a solvent of the fluid delivered through the tube A—as, for instance, when employing a solution of pyroxylin in the tube A, I may employ ether as a solvent. It will be understood, however, that in all cases it is not necessary that the supplementary fluid should be actually a solvent of the primary fluid. Thus in some cases it may be neutral to the primary fluid—as, for instance, instead of ether in the example just given it may be benzole; but in all cases the supplementary fluid, preferably, should be a more or less good "dielectric," as the presence of a conducting fluid while keeping the verge of delivery free may be detrimental to the disruptive and dispersive action of the convective field. The supplementary fluid or solvent may be conveniently supplied to its delivery-tube B through the branch *f* from any convenient reservoir.

D represents one form of electric-current generator, such as a Wimshurst machine, for the production of high tension or static electricity, *g* being the positive pole thereof and *g'* the negative pole, or conversely. A crank E is provided by which the machine may be

operated, as usual, although a pulley with a belt or cord may be used. The pole *g* is connected by a wire *h* with the adjustable electrode *e*, and the other pole *g'* is connected by a wire *h'* with the adjustable electrode *e'*, as shown, so that by adjusting the distance between the free ends of the electrodes *e e'* a variation of strength of the convective field between them may be correspondingly established. To render this regulation of the strength of the convective field still more effective, I provide as one way of accomplishing this end the supplementary electrodes *i i'*, adjustable toward and from each other, whereby the convective field between the electrodes *e e'* may be short-circuited to a greater or less extent, according to the regulation of the length, and consequently the resistance of the convective field formed across *i i'*, caused by adjustment of the distance between them. The electrodes *e e'* are suitably insulated, so that the field of convective action shall be limited to the space between them. The conductors *h h'* should also be heavily insulated and kept at some distance from the field. Adjacent to but in this instance outside of the field of convective action is arranged one form of collecting mechanism for progressively withdrawing fibers produced by the convective action. This collecting mechanism may conveniently consist of a reel F, provided with means for imparting to it a continuous rotation—as, for instance, the bevel-gearing *l*, operated from a counter-shaft *l'* and driving-pulley *m*. It is best also that the whole device be inclosed in a case G of any suitable size, as indicated by the broken lines in Fig. 1, so that currents of air may be avoided and so that by the use of suitable drying substances or mechanisms the electrical and atmospheric conditions within the case may be kept practically uniform, but more especially when the redemption of the dispersed volatile liquid products is desirable—as, for instance, when collodion is used for the production of fibers the beforementioned dispersed solvents may be drawn off from the interior of the case accompanied by a portion of the gaseous atmospheric contents of the case G—for instance, by the pump K—and the dispersed solvent may be recondensed in any suitable manner, and whatever other vapors may be produced in working my process may be drawn off in like manner and fresh atmospheric or gaseous media substituted.

When the liquid—as, for instance, collodion—is delivered in an attenuated form—as, for instance, in a succession of small drops or spray, as in the spray-delivery, Fig. 3, or in a thin stream, Fig. 2, or multiple streams or sheet, Fig. 4—from the discharge-verge of the delivery device and the electrical machine is operated, the fluid falls freely into the convective field between the terminals *e e'* and the electrical action causes filaments to start out, which quickly set or harden because of the dispersion of their volatile liquid component and form fibers which separate, being mutually repelled, and are attracted by the point *e'*; but before the fibers can touch the point *e'* they are caught and are carried to the reel F, upon which the fibers are wound in a machine like the one herein illustrated. The fibers may be caught by the operator ordinarily by means of a glass rod and are carried to the reel, so that the reeling may begin. If the reeling is continuous, it occasionally happens that from some cause the fibers may break away from their connection with the reel, and in that case they may again be caught and carried to the reel in order that the collecting may continue.

It will be understood that instead of a static machine, such as a Wimshurst or Holtz machine, I may employ for the production of the convective field any other suitable equivalent source of high-tension or static electricity appropriate to the purpose.

In the delivering device shown in Fig. 3 the construction is identical with that shown in Fig. 2, but with the additional feature of a spraying-tube *n* for directing a jet of steam, compressed air, or the like across the outlet-opening of the tube A, producing one form of attenuated delivery into the field suitable for the practice of this process.

In the delivery device shown in Fig. 4 the fluid supplied to the bulb *a* flows through the exit-opening *o* upon an abutment *p*, provided with peripheral apertures *p'*. Said abutment is contained within a hollow tube A', which receives a motion of rotation from a pulley *s* and band *s'* and is incased by an outer tube B' for the reception of the solvent. The tube A' is provided with an enlarged bell-shaped mouth, as shown. As the tube A' is rotated the fluid supplied from the bulb *a* drops upon the abutment *p*, from which it passes through the apertures *p'* to the inner periphery of the tube A' and thence downward to the bell-shaped end thereof, where it is thrown off by centrifugal force into the convective field of discharge. At the same time the solvent or other fluid may be conducted through the casing B' and aperture *t* to the outer periphery of the bell-mouthed exit, whereby the edges thereof are always maintained in operative condition. It will be noted that in this latter form the material is delivered into the field of convective action in the form of a thin sheet which breaks up into streams or drops, whose dimensions may be graduated by varying the amount of fluid supplied to the tube A'. The quantity of supplementary fluid supplied may also be varied by adjusting the tube B' so as to vary the distance of the lower edge of said tube B' from the upper surface of the bell-mouthed end of the tube A', as will be readily understood.

By the word "attenuated" as employed herein and in the claims I refer to dimensions or configuration and not to the condition of fluidity of the fluid as it is delivered into the

convective field. The phenomena resulting from the convective passage of a current of electricity at high tension through a gaseous medium, commonly called "silent discharge," "brush-discharge," and "spray-discharge," are herein referred to as "convective field," "field of convective action," "convective discharge," and "convective action."

Having thus described my invention, what I claim is—

1. In an apparatus for separating from composite fluids the volatile liquid component and breaking up the fixed component thereof, the combination of a source of high-tension electricity, means for feeding the composite fluid into the field of electrical discharge from said source of high-tension electricity, and a feeder for a solvent proximate to the feeding-point of said fluid, substantially as described.

2. The combination, with a source of high-tension electricity, of means for projecting a fluid into the field of electrical discharge from said source of high-tension electricity, an electrical connection from one pole of said source of high-tension electricity to said discharge-point and a feeder for a solvent proximate to said discharge-point, substantially as described.

3. The combination with a source of high-tension electricity of means for projecting a fluid into the field of electrical discharge from said source of high-tension electricity, an electrical connection from one pole of said source of high-tension electricity to said discharge-point, an electrical connection from the other pole thereof to an attracting point or surface, and a feeder for a solvent proximate to said discharge-point, substantially as described.

4. The combination of a vessel having a discharge-orifice, a source of high-tension electricity, an electrical connection from one pole of said source of electricity to the discharge-orifice and mechanism for withdrawing the product from the electrical field, substantially as described.

5. The combination of a vessel having a discharge-orifice, a source of high-tension electricity, an electrical connection from one pole of said source of electricity to the discharge-orifice, an electrical connection from the other pole of said source of electricity to an attracting point or surface and mechanism for withdrawing the product from the field of electrical discharge before reaching said attracting-point, substantially as described.

6. The combination of a vessel having a discharge-orifice, a source of high-tension electricity, an electrical connection from one pole of said source of electricity to the discharge-orifice, mechanism for collecting the product, substantially as described.

7. In an apparatus for electrically producing fibers from composite fluids, the combination of a source of high-tension electricity, means for projecting the composite fluid into the field of electrical discharge thereof, an electrical connection from one pole of said source of electricity to the delivery-point of said composite fluid and a reeling mechanism for reeling the fibers, substantially as described.

8. In an apparatus for electrically producing fibers from composite fluids, the combination of a source of high-tension electricity, means for delivering a stream of a viscous composite fluid into the field of electrical discharge thereof, an electrical connection from one pole of said source of electricity to the delivery-point of said fluid, an electrical connection from the other pole of said source of electricity to an attracting point or surface, and a reeling mechanism for reeling the fibers, substantially as described.

9. In an apparatus for separating the volatile liquid component from the component of fixed substances in composite fluids composed thereof, the combination of a source of high-tension electricity, means for producing a field of convective discharge interposed in the circuit of said source, means for delivering a composite fluid in a free and attenuated form into the path of convective action, and means for conducting a supply of the composite fluid to the delivering device, substantially as described.

10. In an apparatus for separating the volatile liquid component from the component of fixed substances in composite fluids composed thereof, the combination of a source of high-tension electricity, means for producing a field of convective discharge interposed in the circuit of said source, means for delivering a composite fluid in a free and attenuated form into the path of convective action and for proportioning the volume delivered to the dispersive strength of the convective action, means for conducting a supply of the composite fluid to the delivering device and means for collecting the fixed or non-volatile products of the convective action upon the composite fluid, substantially as described.

11. In an apparatus for separating the volatile liquid component from the component of fixed substances in composite fluids composed thereof, the combination of a source of high-tension electricity, means for producing a field of convective discharge interposed in the circuit of said source, means for delivering a composite fluid in a free and attenuated form into the path of convective action and for proportioning the volume delivered to the dispersive strength of the convective action, means for conducting a supply of the composite fluid to the delivering device and means for collecting the fixed or non-volatile products of the convective action upon the composite fluid, and for removing them from proximity to the path of convective action, substantially as described.

12. In an apparatus for separating the volatile liquid component from the component of fixed substances in composite fluids composed thereof, the combination of a source of high-tension electricity, means for producing a

field of convective discharge interposed in the circuit of said source, means for delivering a composite fluid in a free and attenuated form into the path of convective action and for proportioning the volume delivered to the dispersive strength of the convective action, means for conducting a supply of the composite fluid to the delivering device and means for collecting the volatile products of the convective action upon the composite fluid, substantially as described.

13. In an apparatus for separating the volatile liquid component from the component of fixed substances in composite fluids composed thereof, the combination of a source of high-tension electricity, means for producing a field of convective discharge interposed in the circuit of said source, means for delivering a composite fluid in a free and attenuated form into the path of convective action and for regulating the volume delivered to the dispersive strength of the convective action, means for conducting a supply of the composite fluid to the delivering device and means for collecting the volatile products of the convective action upon the composite fluid, substantially as described.

14. In an apparatus for separating the volatile liquid component from the component of fixed substances in composite fluids composed thereof, the combination of a source of high-tension electricity, means for producing a field of convective discharge interposed in the circuit of said source, and for adjusting the length thereof, means for delivering a composite fluid in a free and attenuated condition into the path of convective action, and means for conducting a supply of the composite fluid to the delivering device, substantially as described.

15. In an apparatus for separating the volatile liquid component from the component of fixed substances in composite fluids composed thereof, the combination of a source of high-tension electricity, means for regulating the tension of said source, means for producing a field of convective discharge interposed in the circuit of said source and for adjusting the length thereof, means for delivering a composite fluid in a free and attenuated condition into the path of convective action, and means for conducting a supply of the composite fluid to the delivering device, substantially as described.

16. In an apparatus for separating the volatile liquid component from the component of fixed substances in composite fluids composed thereof, the combination of a source of high-tension electricity, means for producing a field of convective discharge interposed in the circuit of said source, means for delivering a composite fluid in a free and attenuated condition into the path of convective action, means for supplying a supplementary solvent to the device at its verge or place of transition of the composite fluid from the confined to the free state, and means for conducting a supply of the composite fluid to the delivering device, substantially as described.

17. In an apparatus for separating the volatile liquid component from the component of fixed substances in a composite fluid composed thereof, the combination of a source of high-tension electricity, means for producing a field of convective discharge interposed in the circuit of said source, means for delivering a composite fluid in a free and attenuated condition into the path of convective action, means for supplying a supplementary fluid to the delivering device at its verge or place of transition of the composite fluid from the confined to the free state, means for regulating the supply of the supplementary fluid, means for adjusting the position in the field of the delivery of the composite fluid and for proportioning the volume thereof to the dispersive strength of the convective action, and means for conducting a supply of the composite fluid to the delivering device, substantially as described.

18. In an apparatus for separating the volatile liquid component from the component of fixed substances in a composite fluid composed thereof, the combination of a source of high-tension electricity, means for producing a field of convective discharge interposed in the circuit of said source, means for delivering a composite fluid in a free and attenuated condition into the path of convective action, means for supplying a supplementary fluid to the delivering device at its verge or place of transition of the composite fluid from the confined to the free state, means for regulating the supply of the supplementary fluid, means for adjusting the position in the field of the delivery of the composite fluid and for proportioning the volume thereof to the dispersive strength of the convective action, means for conducting a supply of the composite fluid to the delivering device, and means for collecting the fixed or non-volatile products of the convective action upon the composite fluid, substantially as described.

19. In an apparatus for separating the volatile liquid component from the component of fixed substances in a composite fluid composed thereof, the combination of a source of high-tension electricity, means for producing a field of convective discharge interposed in the circuit of said source, means for delivering a composite fluid in a free and attenuated condition into the path of convective action, means for supplying a supplementary fluid to the delivering device at its verge or place of transition of the composite fluid from the confined to the free state, means for regulating the supply of the supplementary fluid, means for adjusting the position in the field of the delivery of the composite fluid and for proportioning the volume thereof to the dispersive strength of the convective action, means for conducting a supply of the composite fluid to the delivering device, and means for collecting the volatile products of

the convective action upon the composite fluid, substantially as described.

20. In an apparatus for separating the volatile liquid component from the component of fixed substances in a composite fluid composed thereof, the combination of a source of high-tension electricity, means for producing a field of convective discharge interposed in the circuit of said source, means for delivering a composite fluid in a free and attenuated condition into the path of convective action, means for supplying a supplementary fluid to the delivering device at its verge or place of transition of the composite fluid from the confined to the free state, means for regulating the supply of the supplementary fluid, means for adjusting the position in the field of the delivery of the composite fluid and for proportioning the volume thereof to the dispersive strength of the convective action, means for conducting a supply of the composite fluid to the delivering device, and means for collecting the fixed or non-volatile products of the convective action upon the composite fluid, and removing them from their proximity to the path of convective action, substantially as described.

21. In an apparatus for separating the volatile liquid component from the component of fixed substances in a composite fluid composed thereof, the combination of a source of high-tension electricity, means for producing a field of convective discharge interposed in the circuit of said source, means for delivering a composite fluid in a free and attenuated condition into the path of convective action, means for supplying a supplementary fluid to the delivering device at its verge or place of transition of the composite fluid from the confined to the free state, means for regulating the supply of the supplementary fluid, means for adjusting the position in the field of the delivery of the composite fluid and for proportioning the volume thereof to the dispersive strength of the convective action, means for conducting a supply of the composite fluid to the delivering device, and means for collecting the volatile products of the convective action upon the composite fluid, and removing them from their proximity to the path of convective action, substantially as described.

22. In an apparatus for separating the volatile liquid component from the component of fixed substances in composite fluids composed thereof, the combination of a source of high-tension electricity, means for regulating the tension of said source, means for producing a field of convective discharge interposed in the circuit of said source and for adjusting the length thereof, means for delivering a composite fluid in a free and attenuated condition into the path of convective action, means for supplying a supplementary fluid to the delivering device at its verge or place of transition of the composite fluid from the confined to the free state, means for regulating the supply of supplementary fluid, means for adjusting the position in the field of the delivery of the composite fluid and for proportioning the volume thereof to the dispersive strength of the convective action, means for conducting a supply of the composite fluid to the delivery device, and means for collecting the fixed or non-volatile products of the convective action upon the composite fluid and removing them from their proximity to the path of convective action, substantially as described.

23. In an apparatus for separating the volatile liquid component from the component of fixed substances in composite fluids composed thereof, the combination of a source of high-tension electricity, means for regulating the tension of said source, means for producing a field of convective discharge interposed in the circuit of said source, and for adjusting the length thereof, means for delivering a composite fluid in a free and attenuated condition into the path of convective action, means for supplying a supplementary fluid to the delivering device at its verge or place of transition of the composite fluid from the confined to the free state, means for regulating the supply of supplementary fluid, means for adjusting the position in the field of the delivery of the composite fluid and for proportioning the volume thereof to the dispersive strength of the convective action, means for conducting a supply of the composite fluid to the delivery device, and means for collecting the volatile products of the convective action upon the composite fluid and removing them from their proximity to the path of convective action, substantially as described.

In testimony whereof I affix my signature in presence of two witnesses.

JOHN F. COOLEY.

Witnesses:

ALEXANDER S. STEWART,

M. B. COLE.