

No. 671,507.

Patented Apr. 9, 1901.

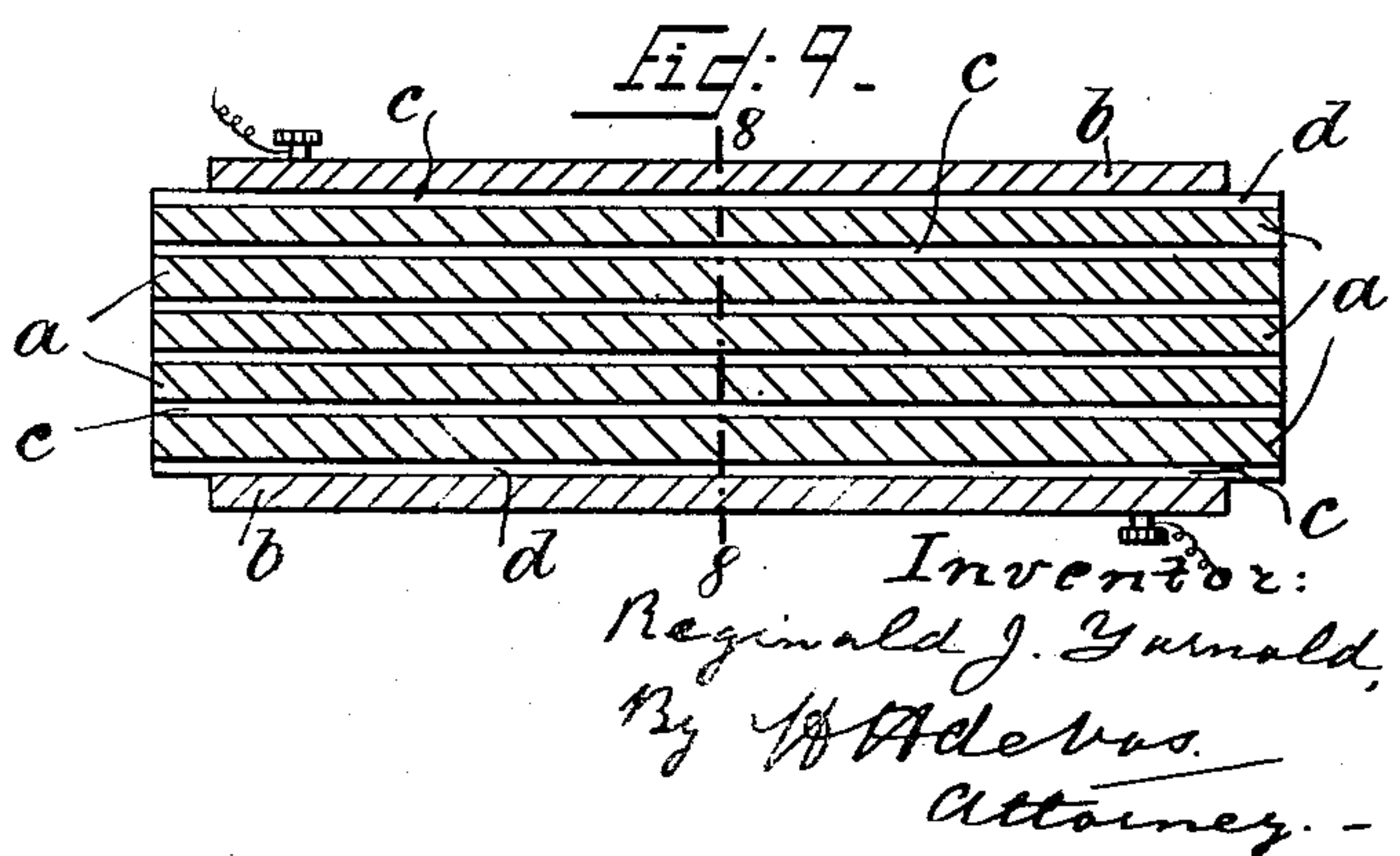
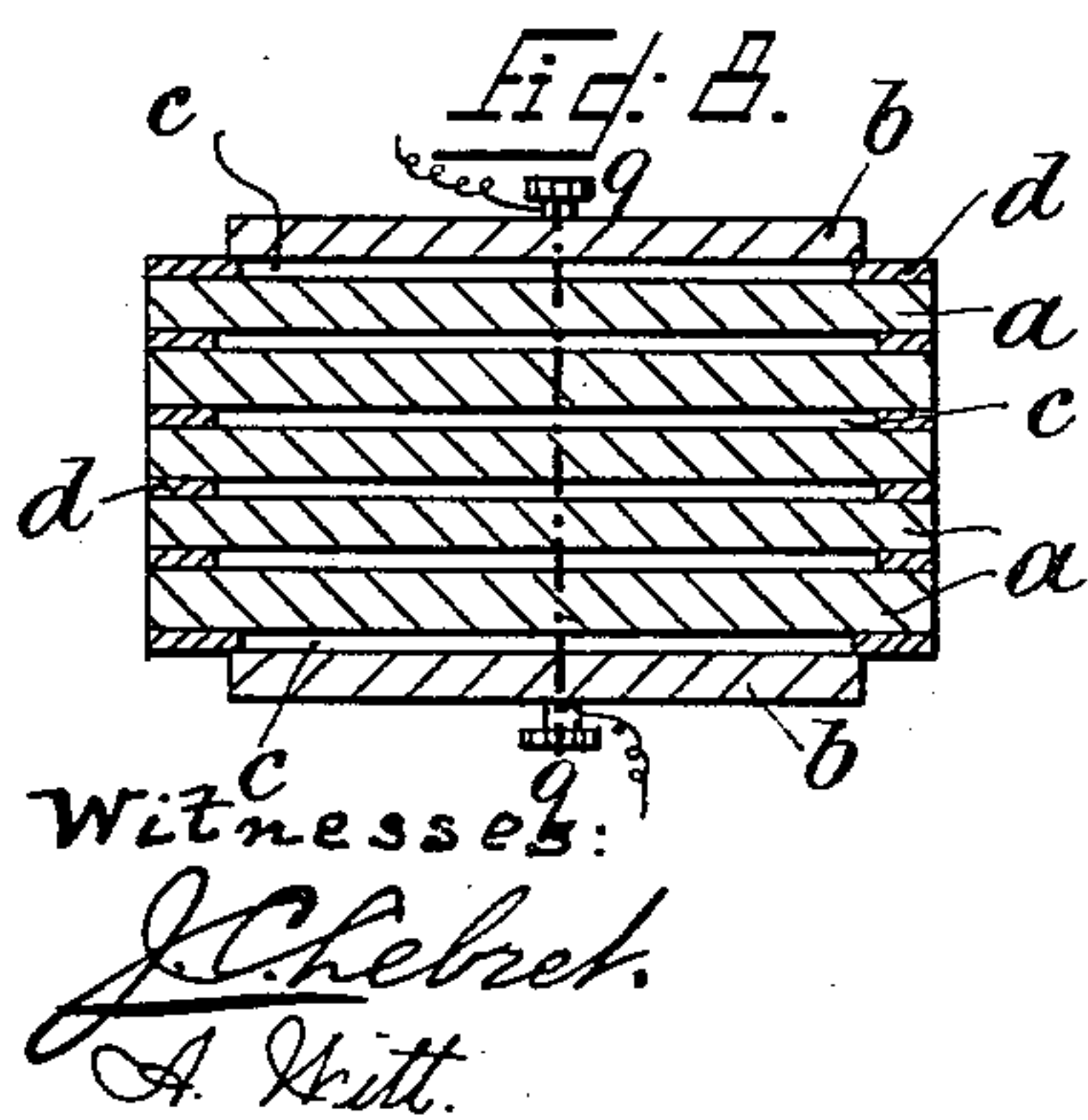
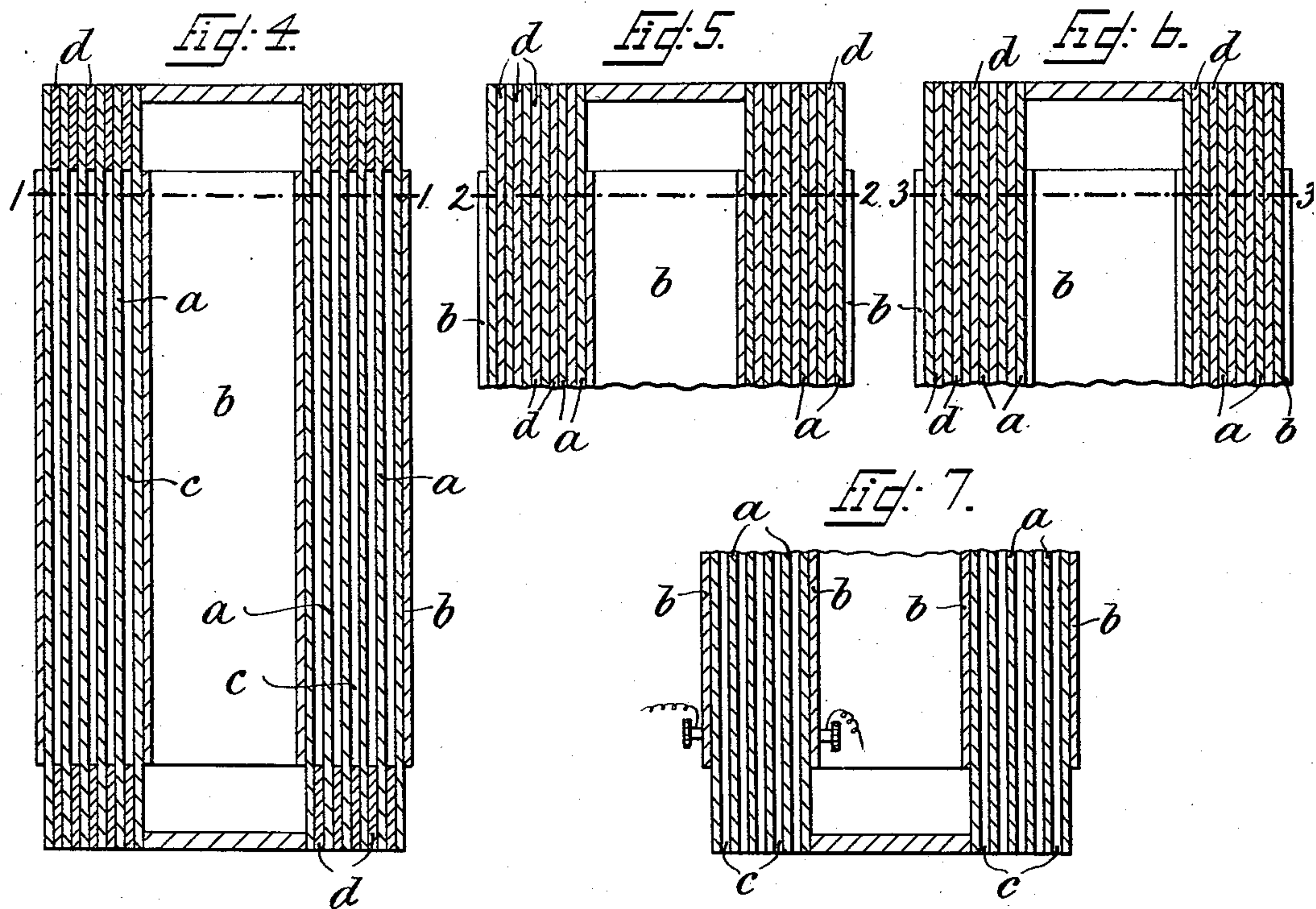
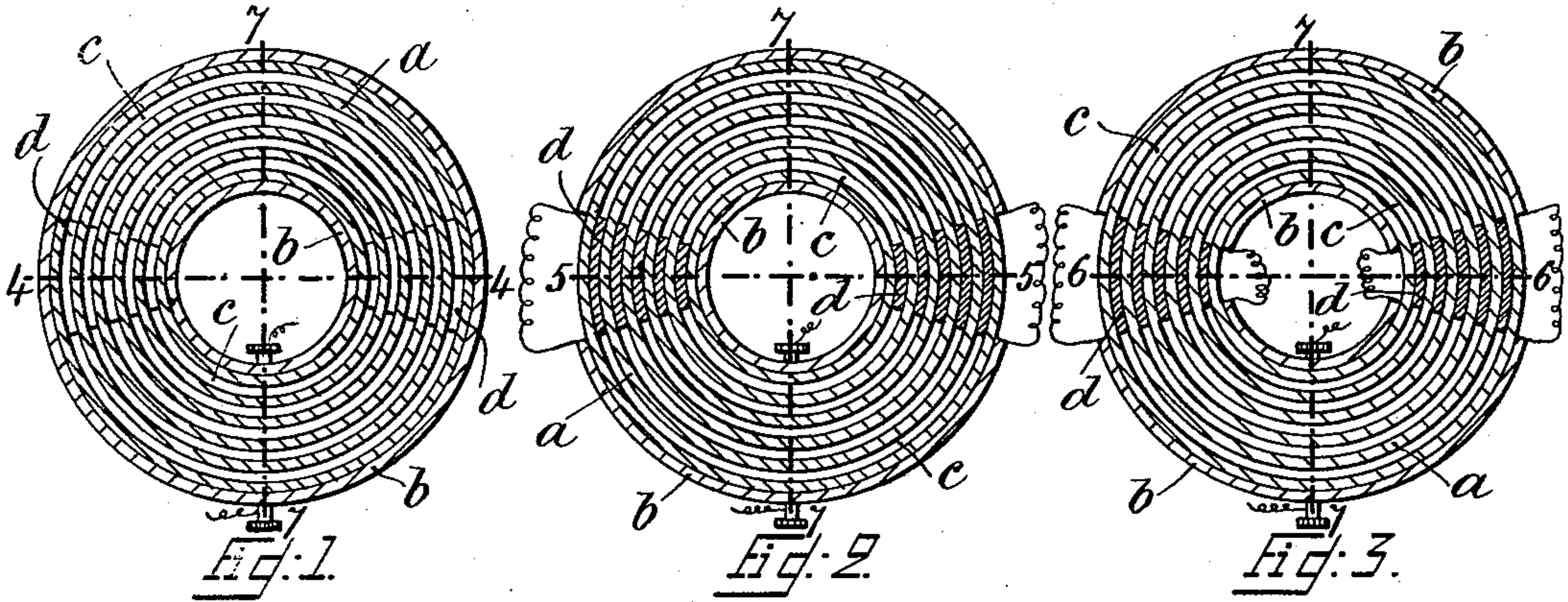
R. J. YARNOLD.

APPARATUS FOR ELECTRICALLY TREATING GASES.

(Application filed Aug. 29, 1899.)

(No Model.)

2 Sheets—Sheet 1.



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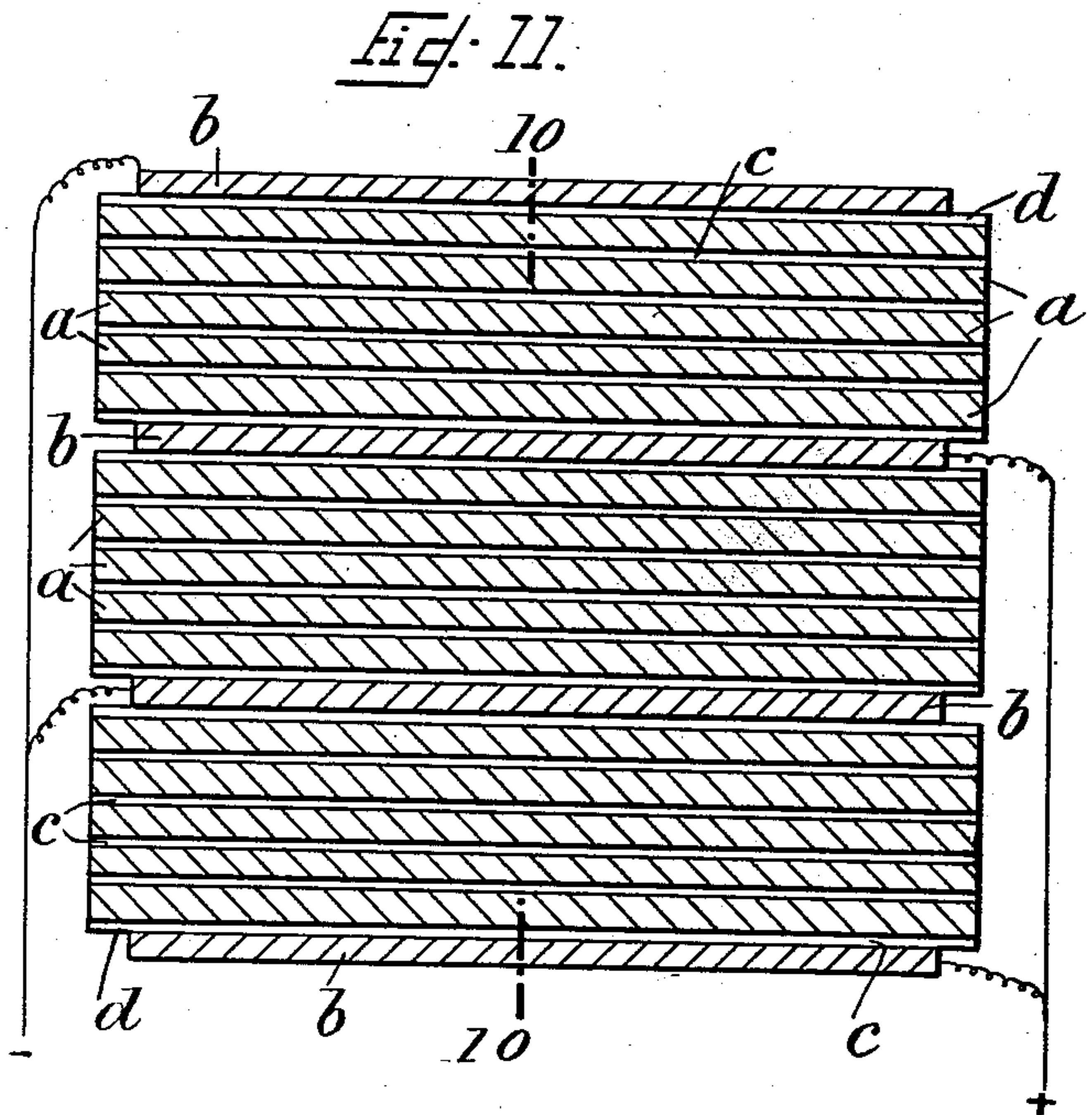
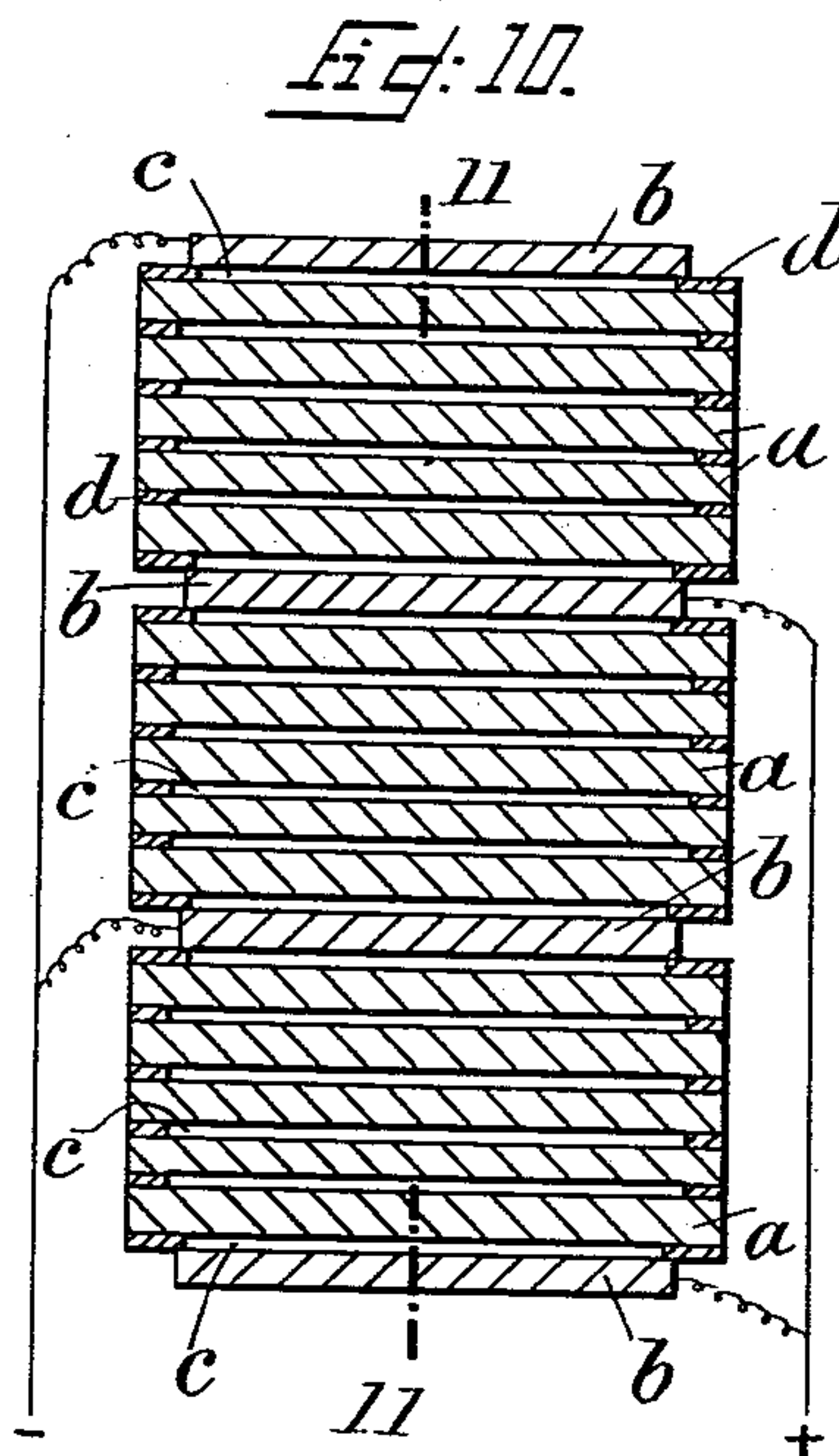
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APPARATUS FOR ELECTRICALLY TREATING GASES.

(No Model.)

(Application filed Aug. 29, 1899.)

2 Sheets—Sheet 2.



Witnesses:  
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# UNITED STATES PATENT OFFICE.

REGINALD JOHN YARNOLD, OF STREATHAM, ENGLAND.

## APPARATUS FOR ELECTRICALLY TREATING GASES.

SPECIFICATION forming part of Letters Patent No. 671,507, dated April 9, 1901.

Application filed August 29, 1899. Serial No. 728,852. (No model.)

*To all whom it may concern:*

Be it known that I, REGINALD JOHN YARNOLD, chemist, a subject of the Queen of Great Britain and Ireland, and a resident of 44 Sternhold avenue, Streatham, county of Surrey, England, have invented certain new and useful Improvements in Apparatus for Electrolyzing or Electrically Treating Gases and Gaseous Mixtures or Compounds, (for which I have filed applications for patents in Great Britain on February 6, 1899; in Belgium on June 28, 1899; in France on July 6, 1899, and in Germany on July 15, 1899,) of which the following is a specification, such as will enable others skilled in the art to which it appertains to make and use the same.

This invention relates to improved apparatus to be employed in the electrical treatment of air for converting the contained oxygen into the allotropic form known as "ozone" and of other gases or gaseous mixtures or compounds for electrolyzing or effecting the allotropic modification thereof.

The improved apparatus is characterized by a combination of electrodes and interposed dielectrics in which a plurality of dielectrics of a higher dielectric capacity than that of the air or gas to be treated and respectively separated or spaced apart by distance-pieces also of a higher dielectric capacity than that of the air or gas under treatment is interposed between a pair or between each two adjacent ones of a series of electrodes in circuit with a source of electric energy in such a manner as to form an air or gas channel, respectively, between each two adjacent dielectrics and between each adjacent dielectric and electrode and a consequent plurality of such air or gas channels alternating with such plurality of dielectrics between adjacent electrodes, so that an electric discharge between adjacent electrodes will be caused to pass through a plurality of separating or interposed and respectively separated dielectrics and across a plurality of air or gas channels of less dielectric capacity alternating therewith.

On the accompanying drawings, Figures 1 to 3 represent the apparatus in three modifications of cylindrical form, in transverse section, respectively, through 1 1, 2 2, and 3 3, Figs. 4 to 6, showing a pair of electrodes with

an interposed plurality of respectively separated channel-forming dielectrics. Figs. 4 to 6 represent longitudinal sections of Figs. 1 to 3, respectively, through 4 4, 5 5, and 6 6. Fig. 7 represents a longitudinal section of Figs. 1 to 3 through 7 7. Fig. 8 represents the apparatus, in flat form, in transverse section through 8 8, Fig. 9. Fig. 9 represents a longitudinal section through 9 9, Fig. 8. Fig. 10 represents the apparatus, in flat form, in transverse section through 10 10, Fig. 11, showing a series of electrodes with an interposed plurality of respectively separated channel-forming dielectrics between each two adjacent electrodes; and Fig. 11 represents a longitudinal section through 11 11, Fig. 10.

*a* represents the channel-forming dielectrics; *d*, the distance-pieces separating the same; *b*, the inclosing or covering electrodes, and *c* the air or gas channels formed by the parts *a b d*.

The dielectrics *a* may consist of glass, mica, or any other suitable substance of a higher dielectric capacity than that of the air or gas to be treated in the apparatus, and the distance or separating pieces *d*, which in the flat forms of the apparatus also aid in forming the air or gas channels, may also consist of the same substance as that of the dielectrics *a* or of any other suitable substance of a higher dielectric capacity than that of the air or gas to be treated in the apparatus.

In the improved apparatus a plurality of the dielectrics arranged cylindrically or flatwise, as represented, or otherwise and horizontally, vertically, or otherwise in parallel and equidistant relation, separated or spaced apart by the distance-pieces *d*, is interposed between a pair of electrodes *b*, Figs. 1 to 9, or between each two adjacent ones of a series of electrodes *b*, Figs. 10 and 11, in circuit with a source of electric energy in such a manner as to form an air or gas channel *c*, respectively, between each two adjacent dielectrics and between each adjacent dielectric and electrode, and a consequent plurality of such air or gas channels alternating with such plurality of dielectrics between adjacent electrodes, so that an electric discharge between adjacent electrodes will be caused to pass through a plurality of separating or inter-



posed and respectively separated dielectrics and across a plurality of air or gas channels of less dielectric capacity alternating therewith.

5 I am aware that in apparatus hitherto used for the purpose of the invention combinations of alternating electrodes and dielectrics have been employed, so arranged either so that  
10 but a single air or gas channel is formed between adjacent electrodes, between one thereof and the interposed dielectric, or so that but two such channels are formed between adjacent electrodes, one between each thereof and the interposed dielectric; but such  
15 arrangements are subject to the practical disadvantages of an excessive electrode or discharging surface in proportion to the air capacity, a corresponding low-current density, a considerable fall of potential difference between the electrodes and ununiformity of  
20 discharge, resulting in a relatively low electrochemical efficiency of action on the air or gas under treatment, and a correspondingly poor result as regards the ozonizing of the air or  
25 the other desired allotropic modification of the gas under treatment. All these disadvantages are avoided in the improved apparatus, which is of advantage in relation to such existing apparatus in that in apparatus  
30 of the corresponding air capacity and worked under a current of the corresponding electric potential the improved apparatus has a considerable less electrode or discharging area in proportion to the air capacity, a correspond-  
35 ingly-increased density of discharging-current per unit of discharging area, and a more uniform discharge through the air or gas under treatment, and also more constantly maintains the electric potential and lessens the  
40 liability of short-circuiting, and thus produces a higher electrochemical efficiency of action on the air or gas under treatment and a proportionately-increased ozonizing of the air or other allotropic modification of the gas, as  
45 the case may be, whereby the chemical activity of such products will be more highly increased and their utilization in the arts will be considerably extended.

50 The improved apparatus also enables high potential alternating or pulsating currents of electricity to be employed in effecting the objects of the invention and enables high po-

tential electric induction-discharges to be readily propagated between electrodes placed at a distance apart, across which a like dis- 55 charge could not be propagated in said existing arrangements.

What I claim as my invention, and desire to secure by Letters Patent, is—

1. In an apparatus for electrolyzing or elec- 60 trically treating gases and gaseous mixtures or compounds, the combination with electrodes in circuit with a source of electrical energy, of a plurality of respectively separated channel-forming dielectrics interposed 65 between each two adjacent electrodes and so arranged as to form an air or gas channel between each two adjacent dielectrics and between each adjacent dielectric and electrode and so as to divide the space between adja- 70 cent electrodes into a plurality of such air or gas channels alternating with such plurality of dielectrics, substantially as shown and described.

2. In an apparatus for electrolyzing or elec- 75 trically treating gases and gaseous mixtures or compounds, the combination with a plurality of independent gas chambers or passages for the passage of the gas, the walls of which chambers are formed of dielectric ma- 80 terial separating the chambers one from another, of electrodes arranged so that the inductive effect of the electric current between adjacent electrodes will be caused to pass successively through a plurality of dielectric 85 walled independent gas passages or chambers, substantially as shown and described.

3. In an apparatus for electrolyzing or elec- trically treating gases and gaseous mixtures or compounds, the combination with a plu- 90 rality of concentric gas chambers or passages for the passage of the gas, the walls of which chambers are formed of dielectric material, of a central electrode or electrodes, and a cor- responding electrode or electrodes exterior to 95 the outer gas passage or chamber, substantially as shown and described.

Signed at London, England, this 18th day of August, 1899.

REGINALD JOHN YARNOLD.

Witnesses:

CHARLES AUBREY DAY,  
ARTHUR WALTER DAY.