No. 786,325. PATENTED APR. 4, 1905.

P. H. THOMAS.

ELECTRICAL CONDENSER.

APPLICATION FILED JULY 16, 1903.

2 SHEETS—SHEET 1.

Fig. 1.

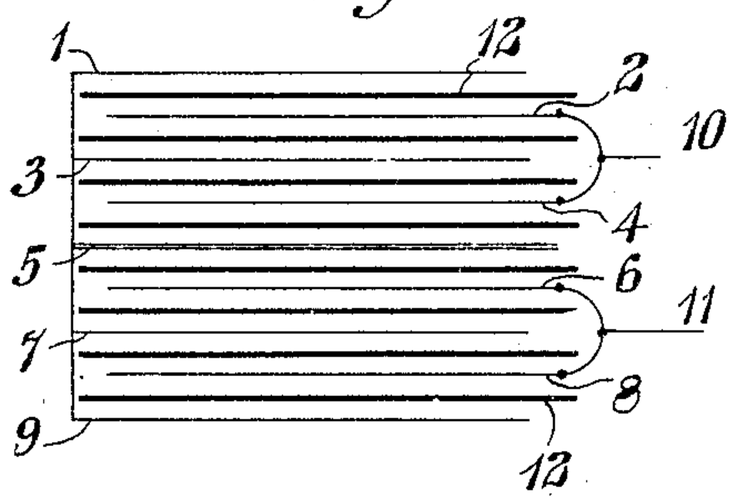


Fig. 2.

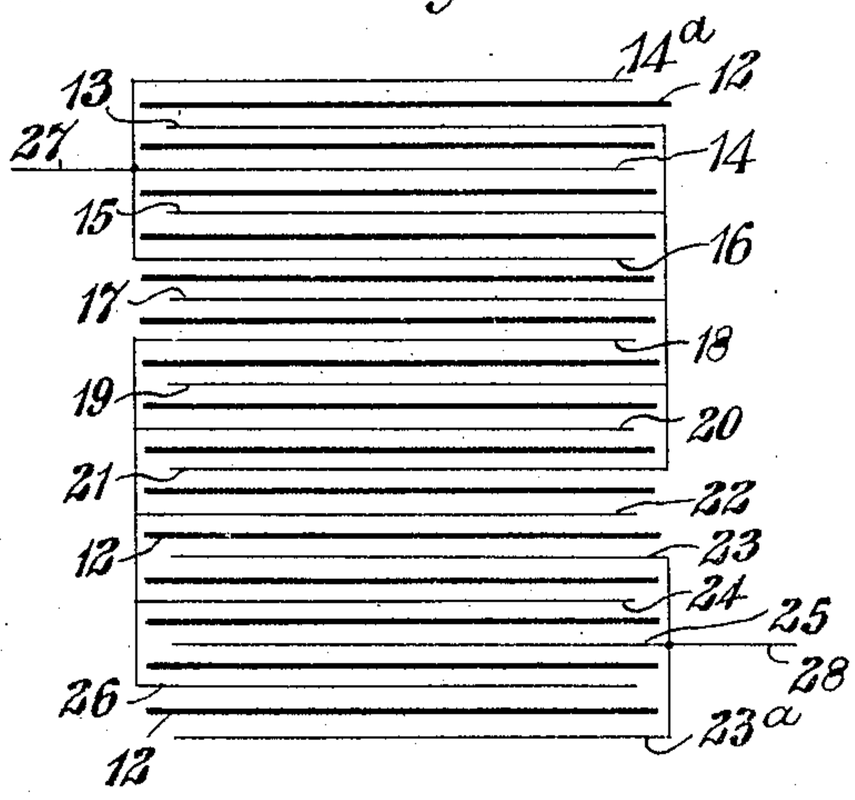
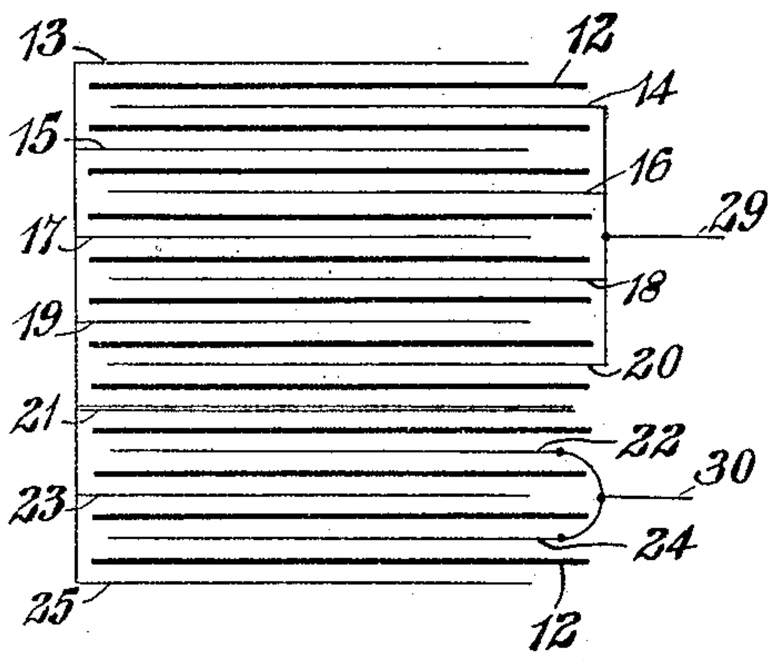


Fig. 3.



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2 SHEETS—SHEET 2.

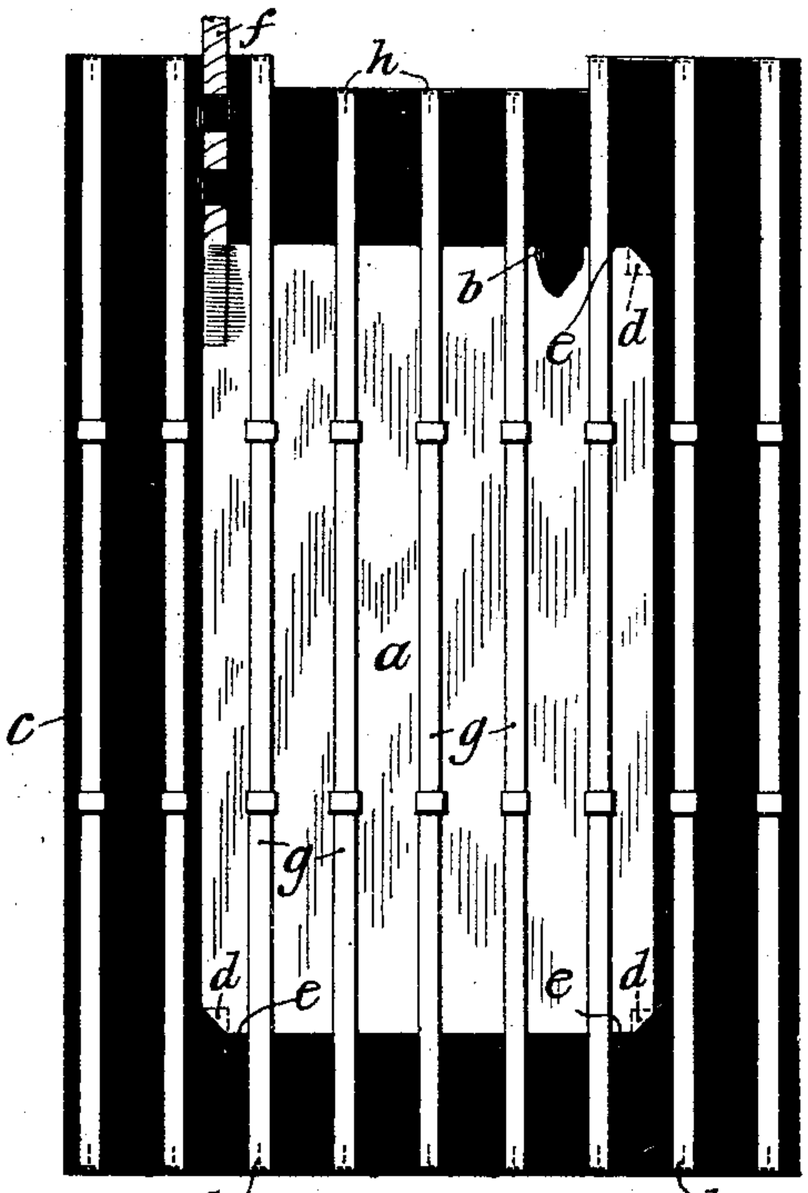

Fig. 4.

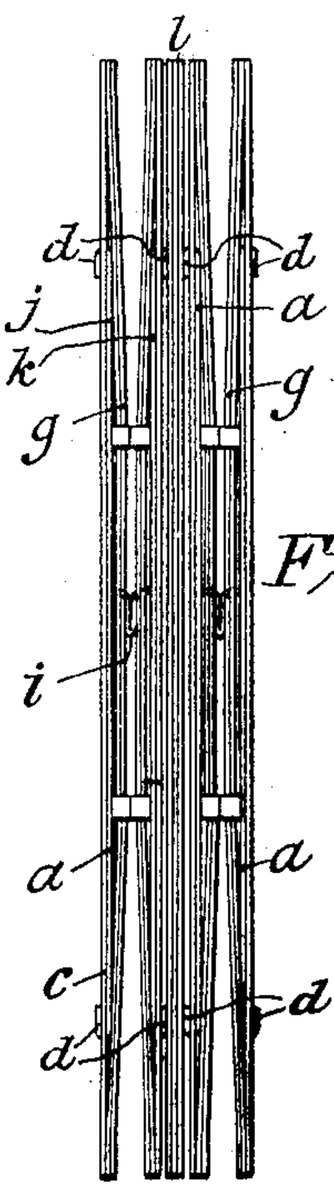

Fig. 6.

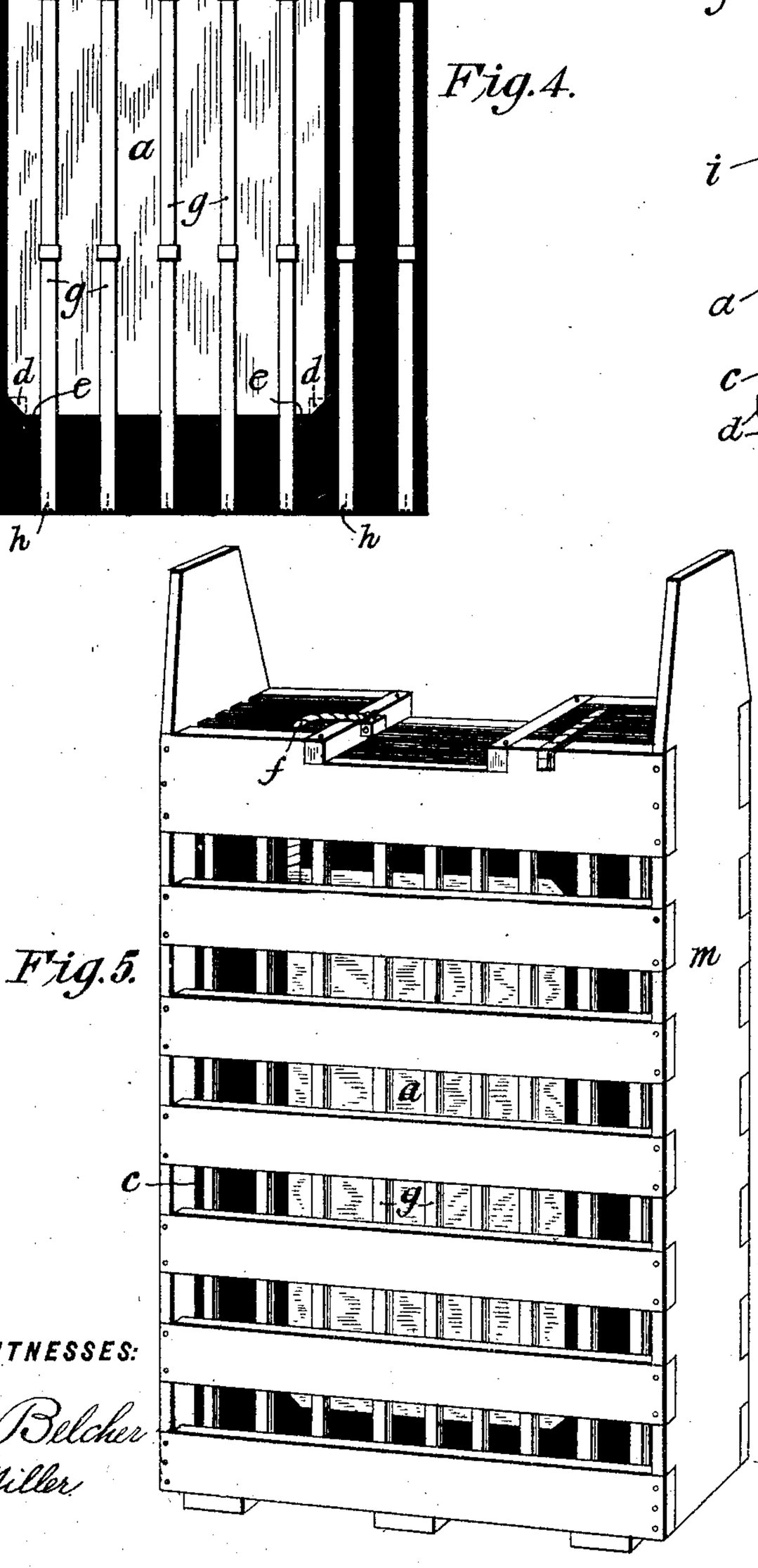

Fig. 5.

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UNITED STATES PATENT OFFICE.

PERCY H. THOMAS, OF PITTSBURG, PENNSYLVANIA, ASSIGNOR TO WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY, A CORPORATION OF PENNSYLVANIA.

ELECTRICAL CONDENSER.

SPECIFICATION forming part of Letters Patent No. 786,325, dated April 4, 1905.

Application filed July 16, 1903. Serial No. 165,887.

To all whom it may concern:

Be it known that I, PERCY H. THOMAS, a citizen of the United States, and a resident of Pittsburg, in the county of Allegheny and State of Pennsylvania, have invented a new and useful Improvement in Electrical Condensers, of which the following is a specification.

My invention relates to electrical condensers, and primarily to condensers used in the protection of electrical apparatus from sudden changes of static potential, though not necessarily limited as regards the character of service.

In the use of condensers constructed in accordance with the usual practice in connection with high-tension circuits disintegration of the conducting-plates at the terminals often takes place by reason of the proximity thereto of conducting-plates between which and said terminals is a great difference of potential. This disintegrating action may be sufficient to eventually break down the condenser.

It has been found that the strain at high potentials on non-conducting or dielectric materials used between the conducting-plates of condensers is not in proportion to the voltage applied to the condenser-terminals, but that the strain is several times greater when the voltage is doubled. Hence a reduction of potential difference between adjacent conducting-plates to one-half that between the condenser-terminals may and generally does reduce the strain on the dielectric material to a safe value. At the same time such a reduction in voltage decreases the tendency to discharge from one plate to the next adjacent plate over the edges of the dielectric material, permitting the use of smaller widths of insulation, which is not useful so far as the condenser action is concerned.

The object of my invention is to provide a condenser of effective and durable construction in which the difference of potential between adjacent conducting-plates and between the condenser-plates and the terminals is made comparatively small, whereby the above-described advantages are secured.

My invention is illustrated in the accompanying drawings, in which—

Figure 1 is a diagrammatic view of a simple form of condenser or one which reduces the potential difference between adjacent condenser-plates to one-half the potential difference between the condenser-terminals. Fig. 2 represents a more complex arrangement of plates in which the difference of potential between adjacent condenser-plates is reduced to one-third that between the condenser-terminals. Fig. 3 is a diagrammatic view of a form of condenser in which the differences of potential between adjacent conducting-plates in the two sections of the condenser are in the ratio of two to one. Fig. 4 is a view of a single condenser-plate as it appears when mounted. Fig. 5 is a perspective view of a condenser as assembled and placed in a wooden retaining-frame. Fig. 6 is a view of two condenser-plates as arranged to reduce the tendency to brush discharge from the edges.

In Fig. 1 I have shown two similar condensers connected in series, and hence the voltage between any two adjacent plates is one-half that between the condenser-terminals and also one-half what it would be if a condenser of the usual construction were employed. The tendency to eating away of material at the terminals is thus avoided, and the dimensions of the non-conducting plates may be reduced. Conducting-plates 2 and 4 are connected to one terminal wire, 10, and plates 6 and 8 are connected to the other terminal wire, 11. Alternated with plates 2, 4, 6, and 8 are conducting-plates 1, 3, 5, 7, and 9, which are all connected together in multiple, and alternated with all of the said conducting-plates are non-conducting or dielectric plates 12. A single plate may be connected to each terminal, or the number may be greater than two, if desired. In fact, the number and arrangement of the condenser-plates may be modified to vary the potential difference between adjacent plates or to otherwise adjust the condenser to meet the conditions imposed in any given case.

The modification shown in Fig. 2 consists in connecting condenser-plates 14, 14[a], and 16

to one terminal wire 27, connecting plates 13, 15, 17, 19, and 21 together, also plates 18, 20, 22, 24, and 26, connecting plates 23, 23ª, and 25 to the other terminal wire 28, and alternating the plates substantially as shown. As before, non-conducting plates 12 are alternated with all of said conducting-plates. The potential difference between two conducting-plates is thus reduced to one-third that between the condenser-terminals, the tendency to disintegrate the conducting-plates being avoided and the dimensions of the dielectric plates being reduced proportionately. The number of plates connected to the two terminals may be varied according to the condenser capacity required in any given case or as desired; but to meet the conditions described there must be an equal number of plates connected to both terminal wires 27 and 28.

The condenser may also be so constructed that there will be a greater difference of potential between adjacent plates in one section of the condenser than in another section, and these potentials may be in any desired ratio or any fraction of the whole difference of potential between the condenser-terminals. In Fig. 3 I have shown an arrangement of the condenser-plates for a ratio of two to one of the potential differences existing between the plates in the two sections. There are twice the number of plates connected to terminal 29 as to terminal 30. Otherwise the alternation of plates and insulating material is exactly similar to the former cases.

It is evident that I have provided means for reducing the potential difference between adjacent plates and neighboring points in a condenser which permits of a simpler and more economical construction of condensers than is otherwise obtainable, and this without danger of disintegration of the condenser-plates or danger of discharge between adjacent plates over the edges of the dielectric material.

Mechanically the advantages of low strains are accomplished in my invention, as shown in Figs. 4, 5, and 6, by properly connecting and assembling the condenser-plates, which are thin rectangular sheets of copper *a*, with their edges *b* bent or folded back in order to round them, and thus reduce the tendency to discharge from them. Said plates are mounted on sheets of fuller-board *c* or other suitable non-conducting material of somewhat larger dimensions than said conducting-plates for the purpose of increasing the length of path for a discharge from one plate to the next. The plates *a* are secured in position by bending back on themselves three of the corners *d*, which are first passed through diagonal incisions *e* in the mounting-board, substantially as shown. To the fourth corner is soldered a narrow sheet-copper lead *f*, which is threaded back and forth through openings in the fuller-board *c*. To afford passages for the circulation of the oil in which the condenser is placed, a plurality of narrow strips of fuller-board *g* or other suitable dielectric material are placed at regular intervals across the conducting-plates and are secured in position by sewing their ends *h* to the sheet *c* of dielectric material, substantially as shown.

In some cases for the purpose of further reducing the tendency to discharge from the edges of the conducting-plates I increase the area of the discharge surface or edge by connecting together at *i* two adjacent plates *j* and *k* in order to make them of the same potential or equivalent to a single plate, said plates being separated only by the spacing-strips *g*, substantially as shown in Fig. 6.

The mounted condenser-plates are assembled with the leads of adjacent plates on opposite sides of the condenser at the top, substantially as shown in Fig. 5, this being done to separate as far as possible leads between which there is a great difference of potential. Between adjacent plates are placed a plurality of sheets of fuller-board *l* or other non-conducting material of the same dimensions as the sheets *c*, upon which the conducting-plates *a* are mounted. The leads which occur together at each side of the top when the plates are assembled are connected together, substantially as shown. The assembled plates are held together by being placed in a suitable wooden frame *m*, and as many of said frames as are desired may be immersed in oil contained in any suitable receptacle. The separate condensers or divisions are connected in series or parallel, according to the voltage of the transmission-line, the voltage which the whole condenser is capable of standing with two halves in series being twice that which it will stand with two halves in parallel, and the strain between adjacent plates when the two halves are in series is one-half that when they are in parallel.

If a condenser having three divisions has said divisions connected in series, the strain between adjacent plates is reduced to one-third that which would occur between said plates if only a single condenser of the ordinary construction were used.

A condenser comprising three divisions may have two of said divisions connected in parallel, which together may be in series with the third division. In this manner the potential difference between adjacent plates in one section of the condenser may be twice that in another section. In a similar manner a condenser may be constructed with any suitable number of divisions which can easily be connected in series or parallel, or a combination of both, to obtain any desired ratio of potential differences between adjacent conducting-plates in the individual sections.

I claim as my invention—

1. An electric condenser comprising a series of non-conducting plates and a series of

thin conducting-plates of less area, each of which has a plurality of corners projecting through slits in the adjacent non-conducting plate and bent backward against the opposite surface to fasten the plate in position.

2. An electric condenser comprising a series of non-conducting plates, a series of thin conducting-plates of less area having a plurality of corners inserted in slits in the adjacent non-conducting plate and bent backwardly against said plate and sets of non-conducting strips having their ends fastened to the ends of the non-conducting plates.

3. An electric condenser comprising a series of non-conducting plates, a series of thin conducting-plates each fastened to an adjacent non-conducting plate by one or more of its corners which project through slits in said non-conducting plate and are bent backward against the plate and each having a terminal strip that is threaded through a plurality of slits in the adjacent non-conducting plate.

4. An electric condenser comprising a series of non-conducting plates, a series of thin conducting-plates of less area each having a plurality of its corners bent and inserted in slits in the adjacent non-conducting plate and having a terminal strip threaded through slits in the non-conducting plate, non-conducting strips having their ends fastened to the ends of the adjacent non-conducting plate and an open-work frame in which said combined members are mounted.

5. An electric condenser comprising a series of non-conducting plates, a series of thin conducting-plates each of which has edges that are folded or turned back upon themselves and is fastened to an adjacent non-conducting plate at its corners.

6. An electric condenser comprising a series of non-conducting supporting-plates, a series of conducting-plates of less area having turned-over edges and each of which is fastened to an adjacent non-conducting plate at its corners and spaced non-conducting strips having their ends fastened to the edges of the supporting-plates.

7. An electric condenser comprising a series of dielectric plates, a series of conducting-plates of less area each fastened to one side of a dielectric plate, spacing-strips fastened to each dielectric plate which supports a metal plate and an open-work frame which contains and supports the combined plates and strips.

8. An electric condenser comprising a series of dielectric plates, a series of conducting-plates of less area each having its corners inserted in slits in an adjacent dielectric plate, spacing-strips having their ends secured to the edges of the adjacent dielectric plate and an open-work frame in which said structure is contained and supported.

In testimony whereof I have hereunto subscribed my name this 15th day of June, 1903.

PERCY H. THOMAS.

Witnesses:
J. H. JONES,
WM. H. CAPEL.