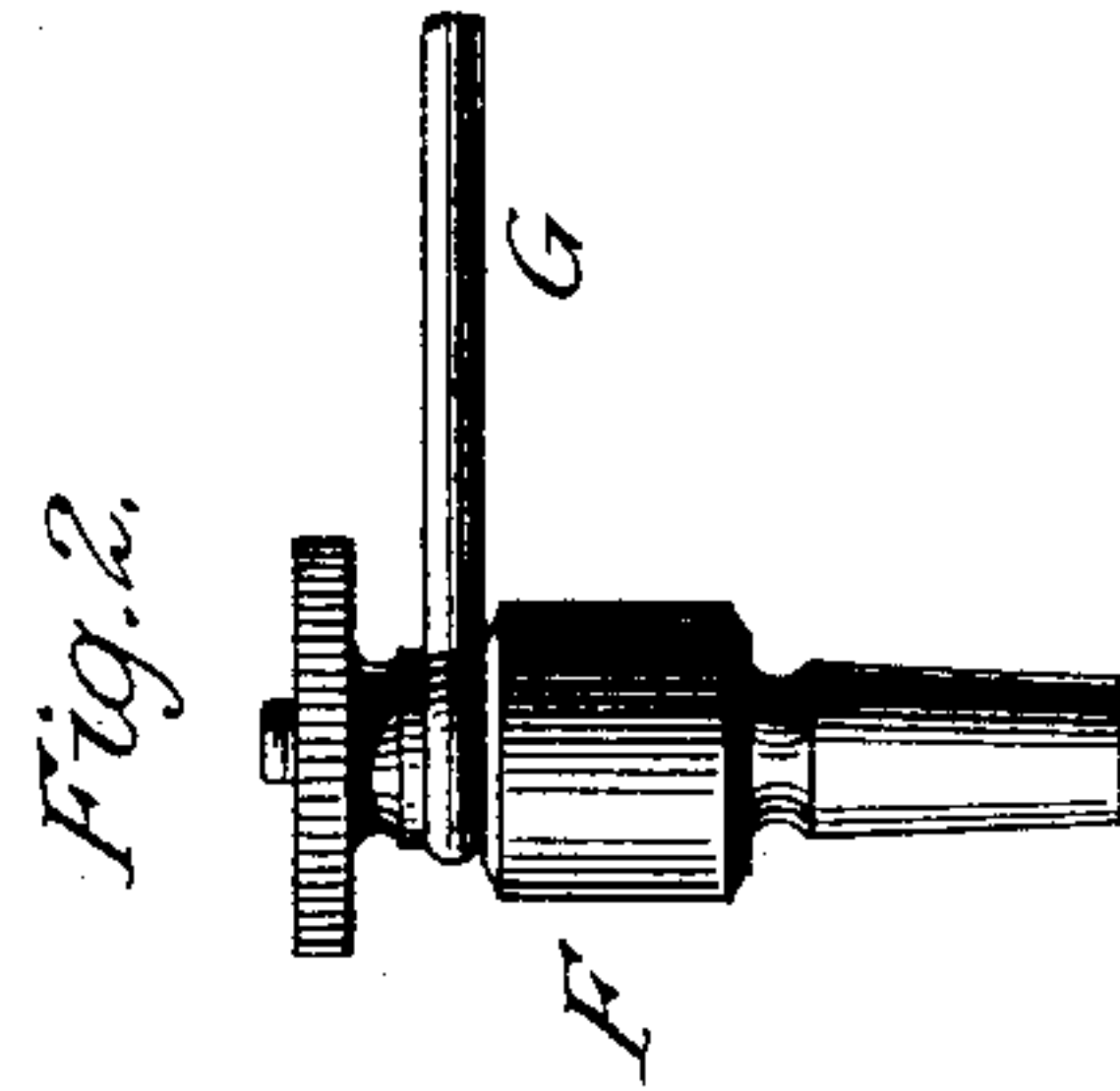
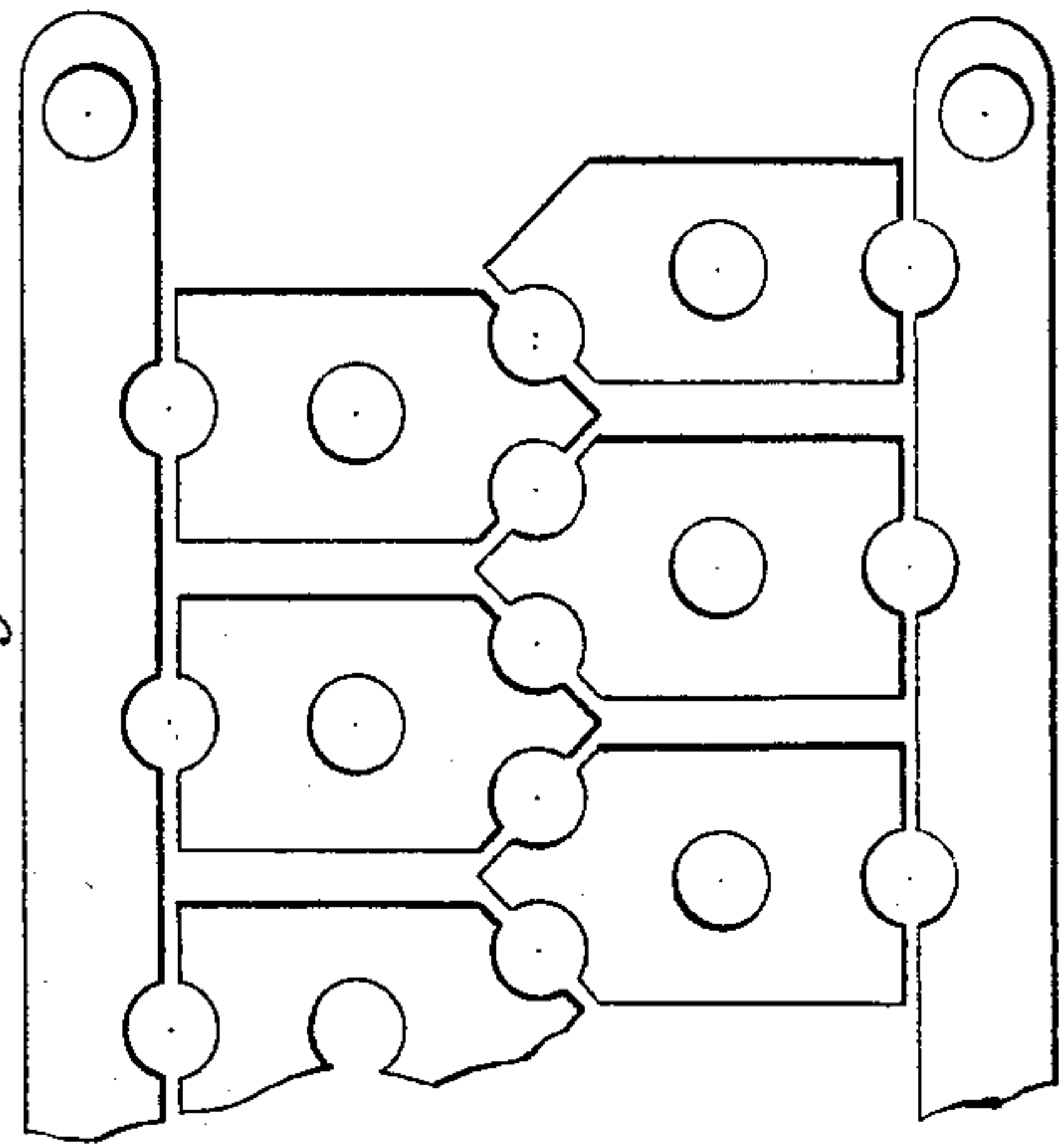
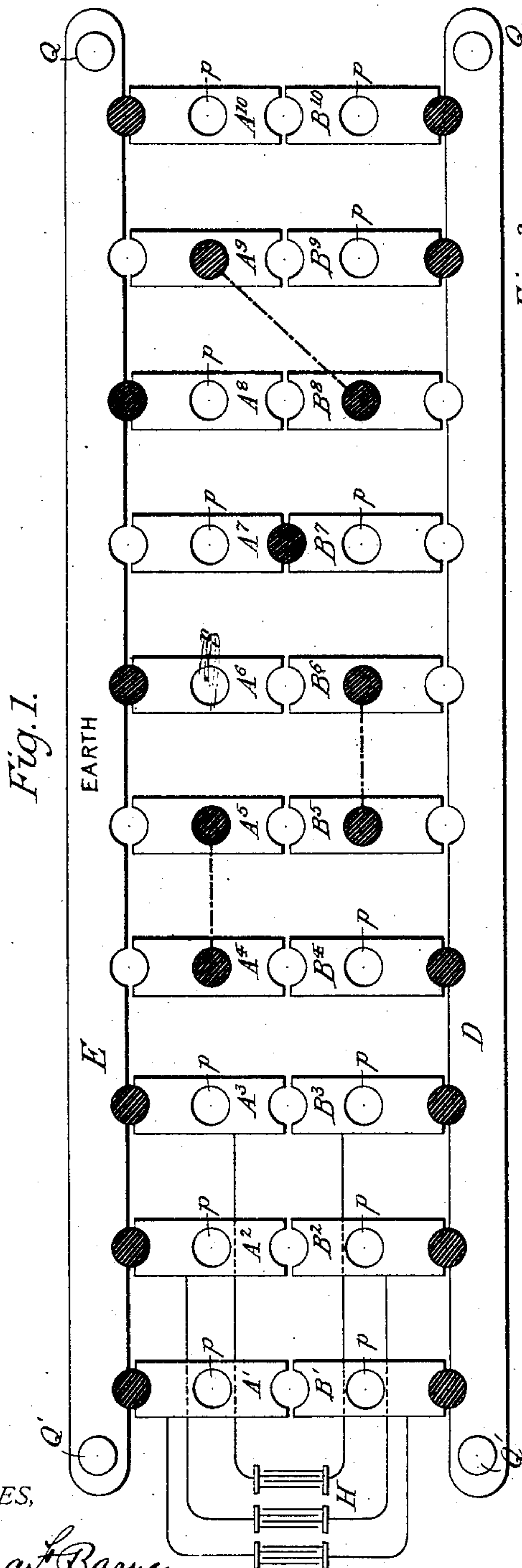


(No Model.)

W. MARSHALL.  
ELECTRIC CONDENSER.

No. 400,866.

Patented Apr. 2, 1889.



WITNESSES,

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# UNITED STATES PATENT OFFICE.

WILLIAM MARSHALL, OF NEW YORK, N. Y.

## ELECTRIC CONDENSER.

SPECIFICATION forming part of Letters Patent No. 400,866, dated April 2, 1889.

Application filed December 20, 1888. Serial No. 294,214. (No model.)

*To all whom it may concern:*

Be it known that I, WILLIAM MARSHALL, a citizen of the United States, residing in the city, county, and State of New York, have  
5 invented certain new and useful Improvements in Electric Condensers, of which the following is a specification.

My invention relates to condenser switch-boards by which from a given sectional condenser or group of condensers any desired  
10 capacity may be obtained; and it consists in a method of connecting condensers to vary the capacity.

An application covering the apparatus herein described was filed by me September 29,  
15 1887, Serial No. 250,994, and allowed September 10, 1888.

In the accompanying drawings, Figure 1 is a plan of my switch-board. Fig. 2 is a view  
20 of a plug therefor, and Fig. 3 is a view of a modified arrangement of switch-board.

In the drawings, A' A<sup>2</sup>, &c., are a series of plates connected each to a positive leaf or group of leaves of a condenser, H, and B' and  
25 B<sup>2</sup>, &c., are a corresponding series of plates connected each to a negative leaf or group of leaves of the condenser.

D and E are two strips adjacent to the two series of plates, respectively, and each plate  
30 is adapted to be connected by a plug, F, with its adjacent strip. The strips are provided at each end with binding-posts Q Q and Q' Q' for the attachment of line-wires.

Each plate is provided with an independent hole for the reception of the plug when  
35 not in use or when a wire connection with some other plate is to be made. Any two corresponding plates of the series, as A' and B', are also adapted to be connected by the  
40 plug, so as to short-circuit the condenser connected therewith.

The plug F, by which all the connections are made, is provided with a binding-post at its upper end adapted to receive the wire G,  
45 by which a connection is made to a corresponding plug, as will be hereinafter described.

In Fig. 3 I have shown a modification of the switch-board, wherein the wire G in some  
50 instances may be dispensed with, the cross-connections being made directly by the plugs.

When a number of condensers are connected in multiple arc, their joint capacity is equal to the sum of their separate capacities. Thus if each condenser of the ten represented in the switch-board of the drawings  
55 should have a capacity of one-tenth microfarad their joint capacity in multiple arc would be one microfarad. When a number of condensers are connected in series, however, their joint capacity is equal to the reciprocal of the sum of the reciprocal of their  
60 respective capacities. Thus the condensers in the condition assumed would have a joint capacity in series of—

$$\frac{1}{\frac{1}{10} + \frac{1}{10} + \frac{1}{10}, \text{ \&c.}} = \frac{1}{30}$$

Therefore the condensers would have a maximum capacity of one microfarad in multiple  
70 arc and a minimum capacity of one one-hundredth microfarad in series.

By means of the switch-board just described I am enabled to readily connect a sectional condenser or a number of condensers, so as  
75 to get not only the maximum and minimum capacities, but any intermediate capacity by a combination of the series and multiple-arc connections. I may also use each section of the condenser separately and for separate  
80 purposes by plugging into the holes *p p*, &c., and attaching the terminals of the several separate lines to each pair of plugs, respectively. Furthermore, I can take all from posts  
85 Q Q with a portion of the condensers connected up either in series or multiple series, and can then use the remainder or a portion thereof by connecting directly to their plugs and not using posts Q' Q'.

To illustrate the manner of combining the  
90 series and multiple-arc connections, the plates A', A<sup>2</sup>, and A<sup>3</sup> are shown plugged to strip E, and the corresponding plates, B', B<sup>2</sup>, and B<sup>3</sup>, to the strip D. The three condensers are thus in multiple arc with a joint capacity of  
95 three-tenths microfarad, and it will be readily seen that the whole can be similarly connected and their maximum capacity obtained—viz., one microfarad. The plates A<sup>8</sup> A<sup>9</sup> and B<sup>8</sup> B<sup>9</sup>  
100 are in series, A<sup>8</sup> being plugged to E, B<sup>8</sup> connected to A<sup>9</sup> by wire G, and B<sup>9</sup> plugged to D. Their joint capacity is thus one-twentieth mi-



crofarad, and it is apparent that the whole number can be similarly connected and their minimum capacity obtained—viz., one one-hundredth microfarad.

5 In combining the different methods of connection to obtain the finer graduations of capacity any group may be connected either in multiple arc or in series, and then treated as a single condenser in the calculation. Thus  
 10 the series group  $A^8 A^9 B^8 B^9$ , having a capacity of one-twentieth, may be combined in multiple arc with  $A^{10} B^{10}$ , having a capacity of one-tenth, and their joint capacity will be one-twentieth plus one tenth, which will equal  
 15 three-twentieths. The same series group may be combined with the multiple-arc group  $A' A^2 A^3 B' B^2 B^3$ , having a capacity of three-tenths, and the joint capacity would then be one-twentieth plus three-tenths, equaling  
 20 seven-twentieths. In like manner any number of sections in series grouping which tends to minimize the capacity may be added in multiple to one or more of the normal capacity and the finest graduations obtained. Like-  
 25 wise multiple-arc groups of equal or different

capacity may be combined in series in an obvious manner. Thus the positive plates  $A^4$  and  $A^5$  are connected by a wire, G, and the negative plates  $B^5$  and  $B^6$  similarly connected. The group thus formed is then placed in series with  $A^6$  and  $B^4$ , which are connected, respectively, to the two strips E and D. 30

Any well-known form of switch may be used in place of plug F, and any section may be short-circuited, as at  $A^7 B^7$ . 35

Having described my invention, I claim—

The method of varying the capacity of a sectional condenser, which consists in grouping two or more sections in series to reduce the individual capacity of the sections and  
 40 combining the group thus formed in multiple arc with one or more individual sections.

In witness whereof I have hereunto signed my name in the presence of two subscribing witnesses.

WM. MARSHALL.

Witnesses:

WM. A. ROSENBAUM,  
 F. C. GRUEN.