April 22, 1924. 1,491,341

A. J. EAVES

CONDENSER

Original Filed Aug. 14, 1918 2 Sheets-Sheet 1

Fig. 1.

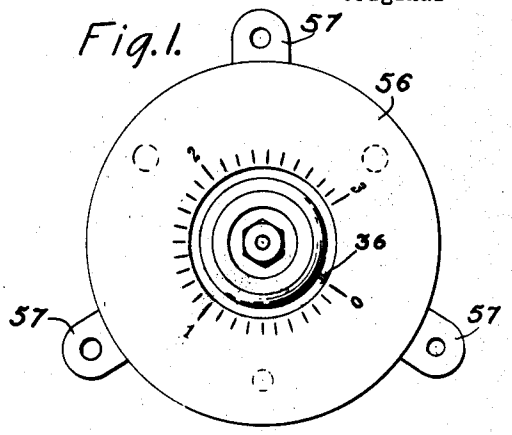



Fig. 2.

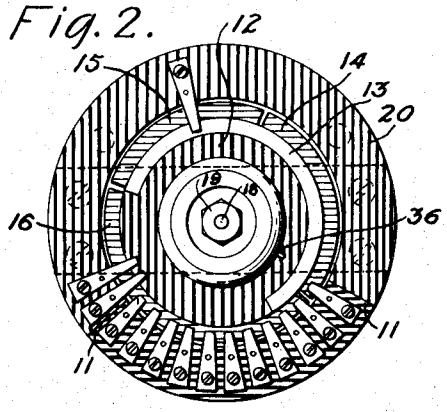



Fig. 3.

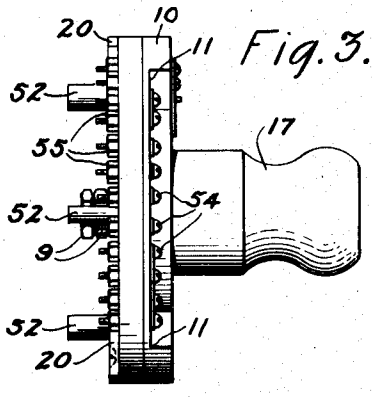
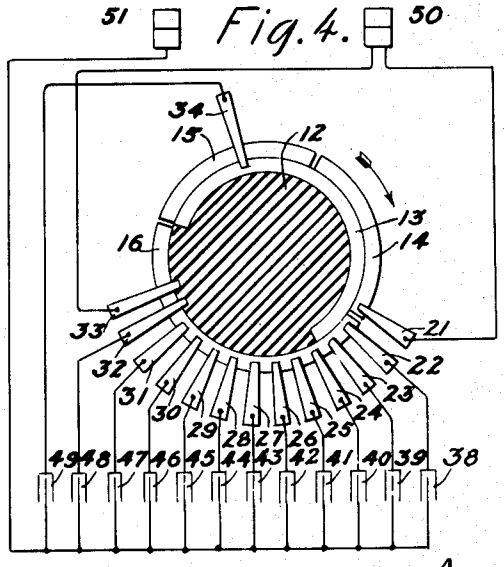



Fig. 4.




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Fig. 5.

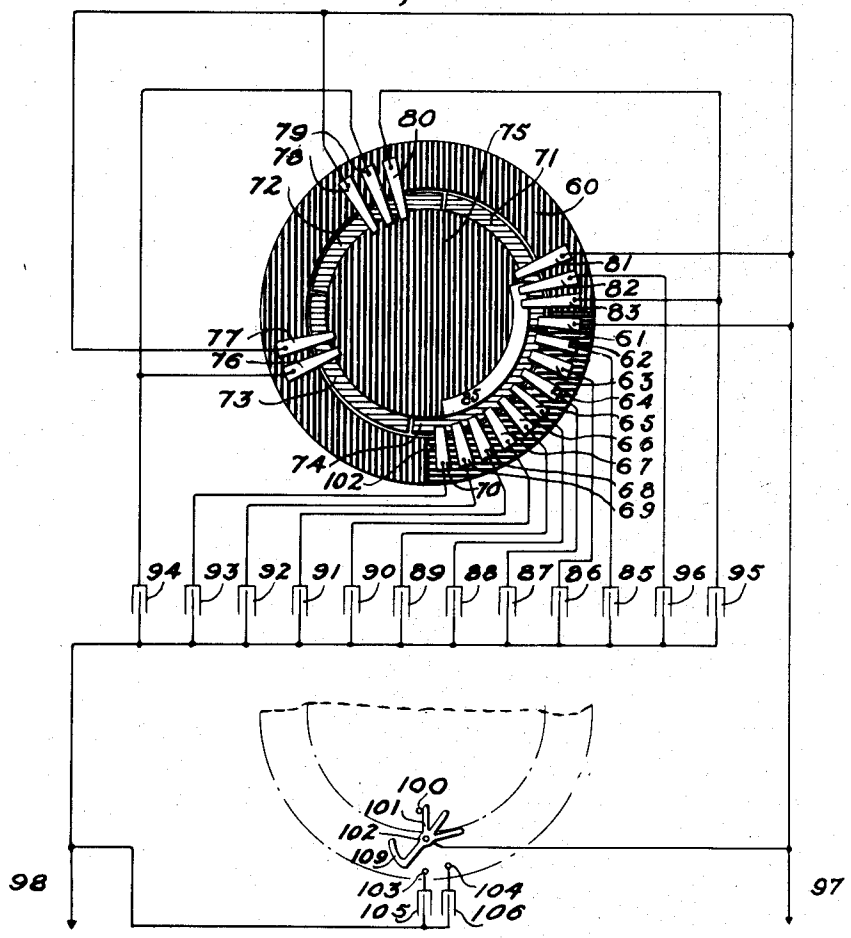
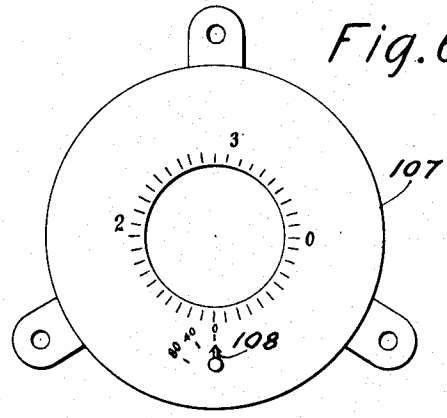



Fig. 6.




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# UNITED STATES PATENT OFFICE.

AUGUSTUS J. EAVES, OF NEW YORK, N. Y., ASSIGNOR TO WESTERN ELECTRIC COMPANY, INCORPORATED, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK.

## CONDENSER.

Original application filed August 14, 1918, Serial No. 249,820. Divided and this application filed December 11, 1919. Serial No. 344,198.

*To all whom it may concern:*

Be it known that I, AUGUSTUS J. EAVES, a citizen of the United States, residing at New York, in the county of New York, State of New York, have invented certain new and useful Improvements in Condensers, of which the following is a full, clear, concise, and exact description.

This invention relates in general to condensers and more particularly to a variable condenser comprising a number of condenser units of various capacities and switching means whereby the total capacity between a pair of line terminals may be varied in the terms of the smallest capacity. This application is a division of my copending application Serial No. 249,820, filed August 14, 1918, relating to a switching device of the preferred type for use with the present invention.

In connection with various communicating systems, there exists a considerable demand for a variable condenser having a relatively large capacity but adjustable within small steps, and to meet this demand it has been a customary practice to provide a large number of small condenser units and a switching arrangement whereby such condenser units can be successively connected in parallel across a pair of line terminals. Such an arrangement however, is not only needlessly expensive because of the large number of condenser units required but in many cases it is too bulky to satisfactorily meet other requirements of the service. To overcome these objections, it is the object of the present invention to provide a variable condenser in which only a small number of condenser units of the minimum capacity will be required, these units being automatically grouped with units of larger capacity in such a manner as to permit an adjustment over the entire range of the apparatus in steps always of the minimum capacity.

A further object of the invention is to provide a variable condenser of the type mentioned which will be small in size, cheap of manufacture and suitably arranged for installing in such a manner that it can be easily manipulated to vary and indicate the capacity between its line terminals.

To accomplish these objects, a feature of the invention resides in providing a switching arrangement combined with condenser units and arranged in such a manner as to successively connect in circuit, the capacity units of minimum value and automatically disconnect such units from the circuit when a unit of larger value is connected in the circuit. This and other features of the invention will be described in the specification and more particularly pointed out in the appended claims.

In the accompanying drawings, Fig. 1 is a top view of a preferred type of switching device embodied in this invention and provided with a suitable casing; Fig. 2 is a top view of the switch shown in Fig. 1 with the casing removed; Fig. 3 is a side view of the switch shown in Fig. 2; Fig. 4 is a diagrammatic view of a variable condenser in which the necessary condenser units are connected in circuit with the switching device of Fig. 2; Fig. 5 is a modified construction provided with an arrangement permitting a larger capacity range; and Fig. 6 is a top view of a suitable casing for the switch of Fig. 5.

Referring more particularly to Figs. 1 to 4, the switching device includes an annular member 10 of suitable insulating material and having a portion cut away, as shown at 11—11. Mounted within the annular member 10 is a rotatable disc-shaped member 12, also of insulating material and having a portion of its periphery cut away to provide a lower level or deck extending entirely around the disc and in a plane with the recessed portions 11—11, while the upper surface or deck is in the plane of the upper surface of member 10. A commutator segment 13 of brass or other suitable conducting material is securely positioned in the edge of the upper deck or member 12, its upper surface being flush therewith. Similarly positioned in the lower level are the segments 14, 15 and 16 which are also of conducting material, and are insulated from each other. A handle 17 suitable for rotating the member 12 is secured thereto by the bolt 18 and nut 19, the bolt extending through member 12 and the metal plate 20 in which it is journaled and fastened by means of nuts 9, 9. Radially mounted on the recessed portion 11 of the annular member are the brushes or contact springs 21 to 31, inclusive. These springs which are insulated from each other are secured to the annular member 10 by means of the screws

54 and nuts 55, being also pinned to prevent them from turning. The free ends of these springs are adapted to bear against the segments 14, 15 and 16 located on the outer and lower edge of member 12 and perform the various switching arrangements in the manner to be described hereinafter. Also radially mounted on the upper surface of member 10 are the brushes or springs Nos. 32, 33 and 34, the free ends of which are adapted to bear against the upper surface of disc 12 and the segment 13 mounted flush therewith. A casing 56 is provided to protect the apparatus from dust and moisture or mechanical injury. This casing, which is arranged to be mounted by screws passing through the mounting brackets 57—57, is provided on its inner periphery with a graduate scale over which sweeps a pointer 36 secured to the handle when the latter is turned. Three standards or spacing members 52, 52 are provided to insure the proper separation when the apparatus is mounted.

As shown in Fig. 4, the springs 22 to 31, inclusive, which bear on the lower level, are electrically connected to condenser units 38 to 47, respectively. These units are of small capacity, $\frac{1}{10}$ m. f. being chosen in the present case. The springs 32 and 34 which bear upon the upper level are connected respectively to condenser units 48 and 49, each of 1 m. f. capacity, and springs 21 and 33 are connected to a line terminal 50. The other line terminal 51 is connected in common to one terminal of each condenser unit. In the position shown, the connections from terminal 50 would be open at springs 21, 33 and the pointer 36 would therefore be opposite the zero mark on the scale, indicating zero capacity. Rotating the handle 17 in a clockwise direction from this position causes segment 14 to engage springs 21 and 22, thereby connecting condenser 38 which is of $\frac{1}{10}$ m. f. capacity between terminals 50 and 51. Additional movement of handle 17 in the same direction increases the capacity between the line terminals in $\frac{1}{10}$ m. f. steps up to the point where springs 21 to 30 are all in engagement with segment 14, thereby connecting condensers 38 to 46 in parallel across the line terminals and giving a total capacity of $\frac{9}{10}$ m. f. Upon the next step, however, segment 14 leaves spring 21, thereby disconnecting condensers 38 to 46, but at the same time segment 13 has progressed far enough to bridge springs 32 and 33 and in so doing connects condenser 48, which is of 1 m. f. capacity, between the line terminals. Upon further rotation, the condensers 38 to 46 are again successively connected across the terminals by the springs 21 to 30 being engaged by the segment 15. During this period, however, the springs 32 and 33 remain in contact with segment 13, hence the capacity between terminals 50 and 51 is increased in $\frac{1}{10}$ m. f. steps until spring 30 is engaged by segment 15, at which time the total capacity between terminals will be $1\frac{9}{10}$ m. f. At the next step segment 15 leaves spring 21, thereby again disconnecting the $\frac{1}{10}$ m. f. condensers, but at the same time the segment 13 has advanced to the point where it engages spring 34 as well as springs 32 and 33, thereby connecting condenser 49 which is of 1 m. f. capacity in parallel with condenser 48, also of 1 m. f. capacity, between the terminals. As the handle is rotated further, segment 16 engages springs 21—31, thereby connecting the $\frac{1}{10}$ m. f. units between the terminal in the same manner as already described, and in parallel with the two 1 m. f. condensers. It will be noted that the length of segment 16 is sufficient to engage spring 31 as well as springs 21—30, thereby connecting condensers 38—47 and giving a total capacity of 3 m. f. between line terminals, this capacity having been reached in steps of $\frac{1}{10}$ m. f.

In Fig. 5 there is shown a modified type of condenser suitable for obtaining a total capacity of 11.9 m. f. in steps of $\frac{1}{10}$ m. f. each. In this condenser, the switch is provided with an annular member 60 having a recessed portion in which are mounted the radial contact springs 61 to 70, inclusive, the free ends of these springs being adapted to bear against the segments 71, 72, 73 and 74 located in the lower and outer edge of the rotating member 75. Located upon the upper surface of the annular member 60 are the springs 76, 77, 78, 79, 80, 81, 82 and 83, the free ends of which are adapted to bear upon the upper level of the rotatable member 75 and engage the segment 85 mounted thereon. The springs 62 to 70, inclusive, are connected to condenser units 85 to 93, respectively, each being of $\frac{1}{10}$ m. f. capacity. The springs 76 and 79 are joined together and connected to the condenser 94 which is of 1 m. f. capacity. The springs 80 and 83 are likewise joined together and connected to a condenser 95 of 1 m. f. capacity. Spring 82 is connected to condenser 96 of 2 m. f. capacity. Springs 61, 81, 78 and 77 are connected to one of the line terminals 97, while the other line terminal 98 is connected in common to one terminal of each of the condensers.

Secured in the under side of rotatable member 75 is a pin 100 which is adapted once in each revolution to engage a switching device 101, this device being made rotatable by journaling the shaft 102 in the under side of the annular member 60. Upon the rotation of the switching device 101 its projecting arm 109 is adapted to sweep over contacts 103 and 104 which are connected respectively to condenser units 105 and 106 each of 4 m. f. capacity. The other terminals of these condensers are connected in

common to line terminal 98 and the switching device is electrically connected to line terminal 97.

The apparatus is shown in a position for zero capacity. Upon movement of the rotatable member in a clockwise direction, segment 71 engages springs 61 to 70 in order, thereby successively connecting condenser units 85 to 93 between the line terminals 97 and 98 in the same manner as described in connection with the arrangement shown in Fig. 4, and thus giving a total capacity of .9 m. f. in steps of $\frac{1}{10}$ m. f. each. At the next step, segment 71 leaves spring 61, thereby disconnecting the condensers 85 to 93, inclusive, from the terminal 97, but at the same time segment 85 on the upper level of the movable member has advanced to a point where it bridges the springs 76 and 77, thus connecting the condenser 94 of 1 m. f. capacity between the line terminals. Upon further rotation, the segment 72 bridges contact springs 61 to 70, thus successively connecting condensers 85 to 93 in parallel with the condenser 94, and giving a total capacity of 1.9 m. f. between the line terminals. At this point segment 85 has advanced to the point where it bridges springs 78 and 79 as well as springs 76 and 77. At the next step segment 72 leaves spring 61, thereby disconnecting the nine $\frac{1}{10}$ m. f. condensers. At this point segment 85 has advanced sufficiently far to leave spring 76 and engage spring 80, thereby connecting condensers 94 and 95 each of 1 m. f. capacity between the line terminals. On further rotation, the segment 73 engages springs 61 to 70 in order, thereby connecting condensers 85 to 93 and making a total capacity of 2.9 m. f. connected between the line terminals. At the next step, segment 73 leaves spring 61, thereby disconnecting the nine $\frac{1}{10}$ m. f. units, and at the same time segment 85 has advanced to the point where it leaves spring 79 and engages springs 81 and 82, thus disconnecting condenser 94 and connecting condenser 96 which is of 2 m. f. capacity between the terminals and in parallel with condenser 95. Further rotation causes segment 74 to engage springs 61 to 70 and to connect condensers 85 to 93 between the terminals in successive order. When segment 74 engages spring 70, the rotating circular disc has been rotated thirty-nine steps out of a total of forty steps for a complete revolution, therefore at the next step, condensers 85 to 96 are disconnected from the line terminals and the rotating member is again at its initial position. However, during the fortieth step, the pin 100 secured to the rotating member 75 has engaged the left-hand arm of the switching device 101 and caused its contact member 109 to engage contact 103, thereby connecting condenser 105 which is of 4 m. f. capacity directly between line terminals 97 and 98. As the rotating member is further revolved, the operation is the same as for the first revolution with the exception that condenser 105 is at all times bridged between the terminals. During the second revolution therefore, the capacity between terminals is increased in $\frac{1}{10}$ m. f. steps from 4 m. f. to 7.9 m. f. At the fortieth step of the revolution, the pin 100 strikes the middle arm of switching device 101 and causes contact arm 109 to engage the contacts 103 and 104, thereby connecting condenser 106 which is also of 4 m. f. capacity in parallel with condenser 105 between terminals 97 and 98. Therefore, during the third revolution of the member 75, the capacity between terminals is increased in $\frac{1}{10}$ m. f. steps from 8 m. f. to 11.9 m. f. Obviously, by increasing the number of contacts engaged by the switching device 101, the total capacity of the condenser could be increased to any desired value. The pin 102 which rotates with the switching device 101 is arranged to extend through a suitable opening in casing 107 and is provided with an indicating arrangement 108 which cooperates with a suitable scale on the casing to indicate the number of 4 m. f. units which are connected between the line terminals. The inner perimeter of this casing is also provided with a scale of the same type shown on Fig. 1 to indicate the capacity connected between terminals depending upon the position of the rotating member.

What is claimed is:

1. The combination with a plurality of condenser units of equal and small capacity, of means for progressively connecting said units between line terminals, a condenser unit of large capacity, and means for connecting said unit of large capacity between the line terminals and simultaneously disconnecting all previously connected units of small capacity, and additional means for again progressively connecting the units of small capacity between the line terminals.

2. The combination with a plurality of condenser units of equal and small capacity, of a plurality of condenser units of larger capacity, a switching device adapted to progressively connect said units of small capacity between line terminals and then to automatically disconnect all previously connected units of small capacity simultaneously with connecting a unit of larger capacity between the line terminals.

3. The combination with a plurality of condenser units of small capacity, of a plurality of condenser units each of a capacity equal to one unit more than the total capacity of the small units, means for progressively connecting said small units between line terminals, and means for individually connecting each of said other units between the line terminals and simultaneously

disconnecting all previously connected small units.

4. The combination with a plurality of condenser units of equal and small capacity, of a plurality of condenser units of large capacity, and rotatable means cooperating with said units of small and large capacity for progressively increasing the capacity between line terminals to a maximum in steps of the minimum capacity.

5. The combination with a plurality of condenser units of equal and small capacity, of a plurality of condenser units of large capacity, a rotatable member for progressively increasing the capacity between line terminals for a complete revolution in steps of the minimum capacity, and means operable by the rotatable member once in each revolution for connecting a condenser unit between the line terminals equal in capacity to the total capacity obtained in one revolution of the rotatable member plus the capacity of one of the condenser units of small capacity.

6. The combination with a plurality of condenser units of equal and small capacity, of a plurality of condenser units of various capacities, a rotatable switch member adapted to connect said condenser units in parallel between said terminals in steps of a value equal to the capacity of the smallest unit.

In witness whereof, I hereunto subscribe my name this 8th day of December, A. D., 1919.

AUGUSTUS J. EAVES.