

E. E. F. CREIGHTON.
ELECTROLYTIC CONDENSER COMBINED WITH AUTOTRANSFORMER.
APPLICATION FILED JULY 13, 1907.

933,697.

Patented Sept. 7, 1909.

2 SHEETS—SHEET 1.

Fig. 1

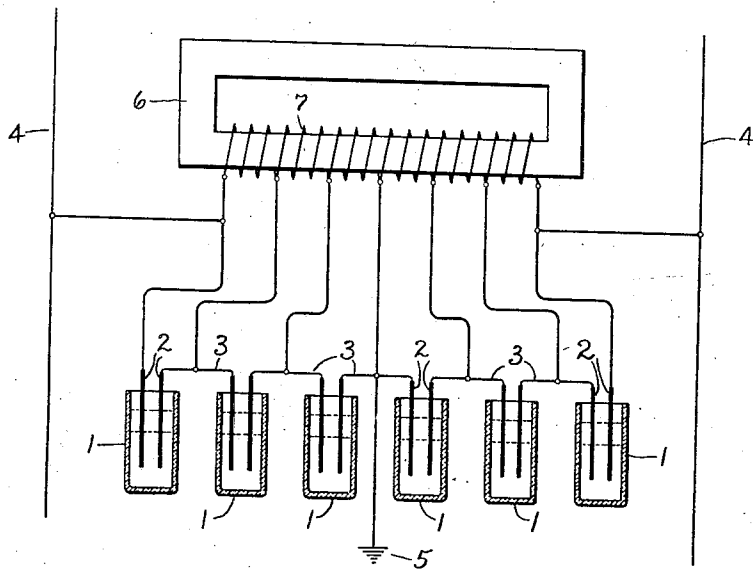


Fig. 2

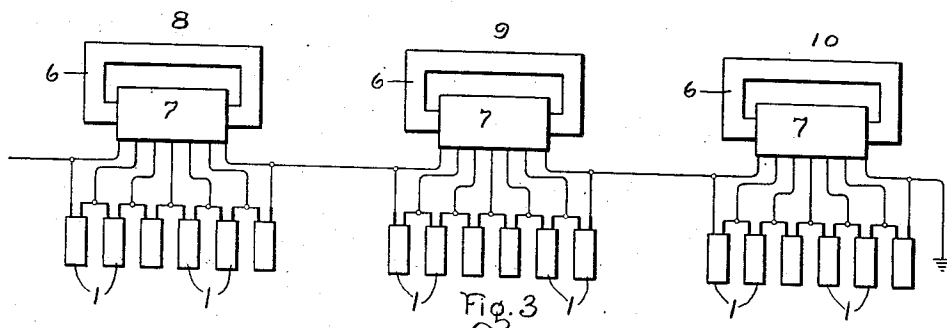
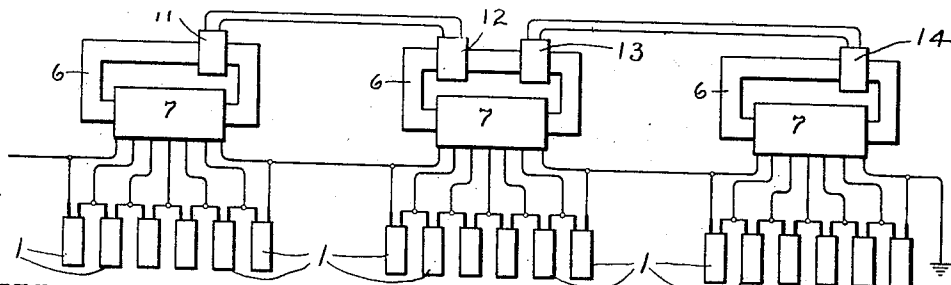


Fig. 3



WITNESSES:

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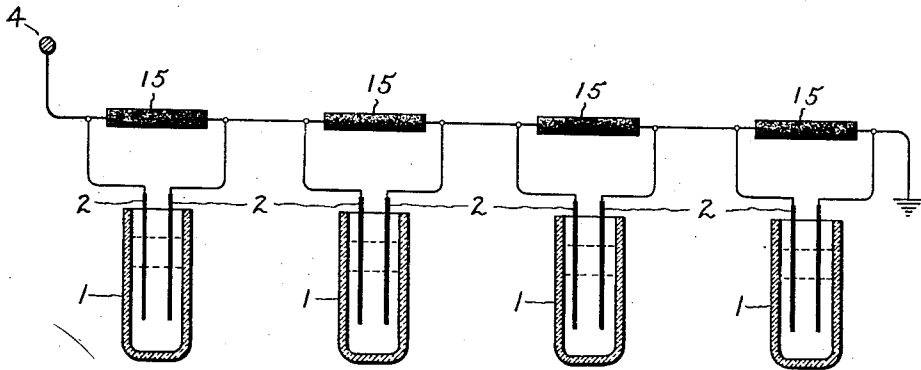
BY *Alfred H. Davis*
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Fig. 4



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Lester H. Palmer.
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UNITED STATES PATENT OFFICE.

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ELECTROLYTIC CONDENSER COMBINED WITH AUTOTRANSFORMER.

933,697.

Specification of Letters Patent.

Patented Sept. 7, 1909.

Application filed July 13, 1907. Serial No. 383,637.

To all whom it may concern:

Be it known that I, ELMER E. F. CREIGHTON, a citizen of the United States, residing at Schenectady, county of Schenectady, State of New York, have invented certain new and useful Improvements in Electrolytic Condensers Combined with Autotransformers, of which the following is a specification.

10 This invention relates to the use of aluminum electrolytic condensers and comprises an arrangement of apparatus including a plurality of condenser cells and an impedance device so connected and coöperating with one another that substantially uniform and equal potential is maintained across successive cells of the condenser and across successive sections of the impedance device.

15 In lightning arresters of the electrolytic condenser type I have proposed in a prior application, Serial No. 325,195, to use a plurality of cells containing aluminum electrodes immersed in a suitable electrolyte and connected in series. The current-limiting effect of this device is due to the thin film of aluminum oxid or hydroxid which forms on each plate when current flows through the cell. The resistance of the film is, however, limited to a certain "critical voltage", and if this is exceeded the film valves open and permit the current of the excessive potential to flow freely. Upon a reduction of the voltage to a value below the critical voltage, the film valves again close and choke back the current. By connecting a number of such cells in series, the total critical voltage of the device can be made sufficiently high to control any given line voltages. When an electrolytic condenser of this type is permanently in circuit between line and ground, there is a small leakage current which keeps the film formed and ready for action. After being in service for some time, however, there is a tendency for the cells to become unbalanced to the extent that one or more cells will cease to do their full share of the work and will thereby increase the strain on the remaining cells. This overloading of the remaining cells may result in further break downs until the effectiveness of the device as a lightning arrester is destroyed. In other words, a series of simple aluminum cells connected permanently in circuit cannot be trusted to maintain among the several cells a uniform and equal distribution of the potential. I have found that if each cell is shunted by an impedance of proper value, the cells will continue to operate in series for an indefinite time. The impedance may be a transformer winding having its coils or sections connected at intervals to the cells of the condenser and preferably in such a way that each cell is shunted by the same amount of impedance or reactance.

60 The accompanying drawing illustrates modes of carrying out my invention.

65 Figure 1 shows a six-cell condenser connected with an autotransformer; Fig. 2 shows a bank of three sets of such cells connected in series; and Fig. 3 shows a similar installation with equalizing coils connecting the transformers.

70 The cells consist of glass jars 1 partly filled with electrolyte above which is a layer of oil to prevent evaporation. The electrodes 2 are aluminum plates; those in adjacent jars being connected in pairs by connectors 3. The end plates in the series are connected to the lines 4 of a transmission system, and the middle plates are grounded at 5.

75 The autotransformer has a core 6, which is preferably a closed magnetic circuit on which is wound the coil 7 divided into portions preferably equal which are connected to the plates 2 in the cells, so as to be in shunt thereto.

80 In operation, whenever one cell becomes abnormal, there is a transference of energy from the other coils of the transformer which tends to equalize the potential. The resistance of a cell depends upon the electrolyte, the thickness of the films on the plates, and other conditions, and the film may increase in thickness, or electrolytic action may eliminate impurities from the electrolyte or from the film, in which case the resistance rises and if constant current is maintained through the cell the difference of potential between the electrodes becomes greater than normal. On the other hand, for example, the film may break down in one spot, there may be an impurity in the plate, or the electrolyte may become impure, in which case the resistance of the cell becomes less than normal and the same potential on the electrodes causes more current to flow, or if the normal current is maintained the difference of potential between the elec-

trodes becomes less. The auto-transformer shown in the drawings is connected across the line and if, for example, the resistance of a cell decreases and consequently the potential between the two electrodes tends to decrease, the transformer winding connected to those electrodes at once begins to furnish energy sufficient to maintain practically the normal difference of potential between the electrodes, in spite of the fact that the resistance of the cell is below normal. Since the cells are all identical, it requires comparatively little energy transfer to maintain almost equal voltage across the cells. In case the installation is a large one, it may be divided into sections 8, 9, 10, as shown in Fig. 2, each with its own autotransformer. Any number may be used, the drawing showing three for convenience, merely. The sections are connected in series between line and line, or line and ground, and the voltage of one section cannot exceed that of the others, because of the self-regulating effect of the connected coils.

In Fig. 3 is shown a further modification, in which the sections are tied together electrically by the equalizing coils 11, 12, 13, 14, the first on the core of section 8, the next two on the core of section 9, and the last on the core of section 10. Coils 11 and 12 are connected in series, and so are coils 13 and 14, and they tend to maintain a uniform flux in all the cores, and thus keep the voltage of all the cells approximately equal.

Fig. 4 shows an equivalent means for maintaining the cells at equal voltage. Instead of an autotransformer, a resistance is shunted across each cell. In this case, if the potential of a cell rises, the resistance in parallel therewith takes more current and tends to equalize. In this construction there is a continuous loss of energy through the resistances, but the first cost is less than that of an autotransformer.

What I claim as new, and desire to secure by Letters Patent of the United States, is,—

1. The combination with an electrolytic condenser, comprising a plurality of cells, of an energy-consuming device in shunt to each cell.

2. The combination with an electrolytic condenser comprising a plurality of cells, of an impedance in shunt to each cell.

3. The combination with an electrolytic condenser comprising a plurality of cells, of impedance coils respectively shunted across said cells, and a magnetic core common to all of said coils.

4. The combination with an electrolytic condenser comprising a plurality of cells, of an autotransformer having a coil in shunt to at least one of said cells.

5. The combination with an electrolytic condenser comprising a plurality of cells, of an autotransformer having its coil divided

into portions, each in shunt to one of said cells.

6. The combination with an electrolytic condenser comprising a plurality of cells, of an autotransformer having its coils divided into equal portions the same in number as said cells, each portion being shunted across its respective cell.

7. The combination with an electrolytic condenser comprising a plurality of cells divided into sections connected in series, of an autotransformer for each section, having its coil divided into portions each in shunt to a cell.

8. The combination with an electrolytic condenser comprising a plurality of cells divided into sections connected in series, of an autotransformer for each section with portions of its coil in shunt to said cells, and means for equalizing the magnetic flux in all of said autotransformers.

9. The combination with an electrolytic condenser comprising a plurality of cells, of an autotransformer having its coil divided into portions, each in shunt to one of said cells, and electrically-connected coils on the cores of said autotransformers.

10. The combination of a transformer winding and a plurality of aluminum condenser cells each in shunt with a portion of said winding.

11. The combination of an inductive device and a plurality of aluminum cells each in shunt with a portion of said device.

12. The combination of a reactance coil and a plurality of aluminum condenser cells shunting equal portions of the winding thereof.

13. The combination with transformer windings, of a plurality of aluminum condenser cells shunting portions of said windings and means for equalizing the magnetic flux in the shunted portions of said windings.

14. The combination with an autotransformer comprising a plurality of windings, of a plurality of aluminum cells each in shunt with a portion of said windings and electrically connected coils mounted in inductive relation to said windings for equalizing the magnetic flux through said windings.

15. The combination with transformer windings, of a plurality of aluminum condenser cells each in shunt with a portion of said windings and coils mounted in inductive relation to said windings, said coils being interconnected to control the magnetic flux in said windings.

In witness whereof, I have hereunto set my hand this 12th day of July, 1907.

ELMER E. F. CREIGHTON.

Witnesses:

BENJAMIN B. HULL,
HELEN ORFORD.