

Feb. 19, 1935.

S. SILBERMANN

1,991,707

HIGH TENSION CONDENSER

Filed Oct. 9, 1931

3 Sheets-Sheet 1

Fig. 1.

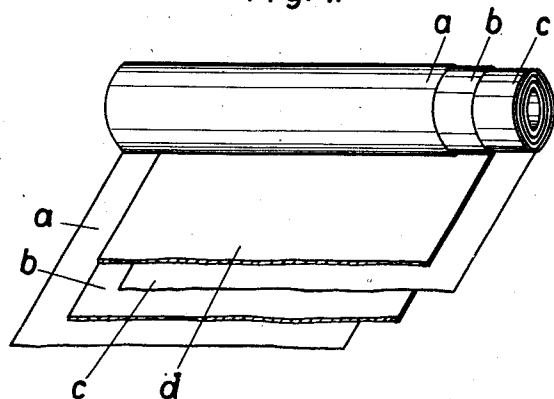


Fig. 2.

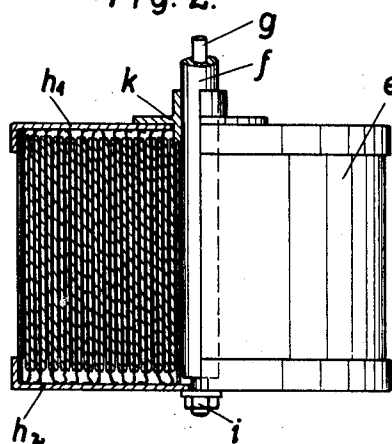


Fig. 3.

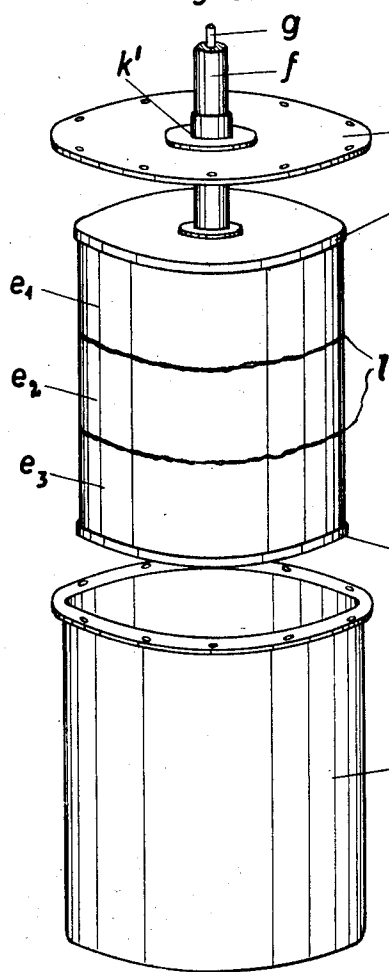
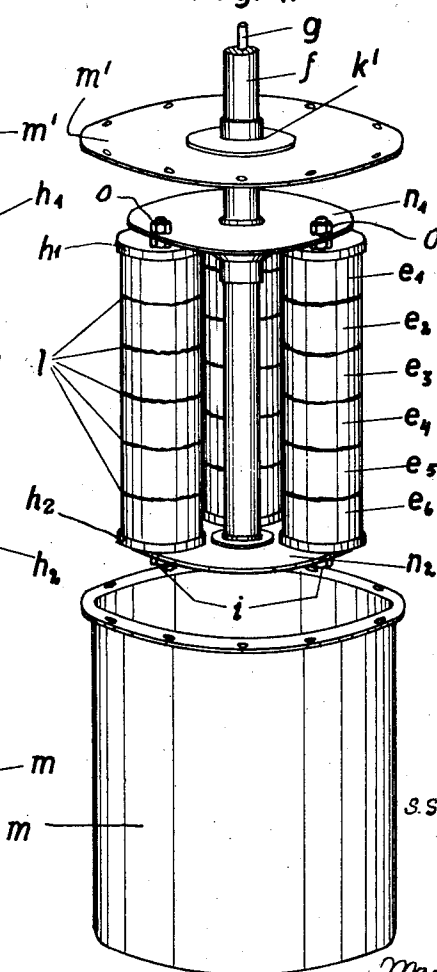


Fig. 4.



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Fig. 5.

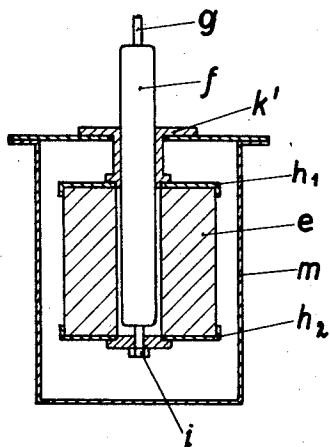


Fig. 6.

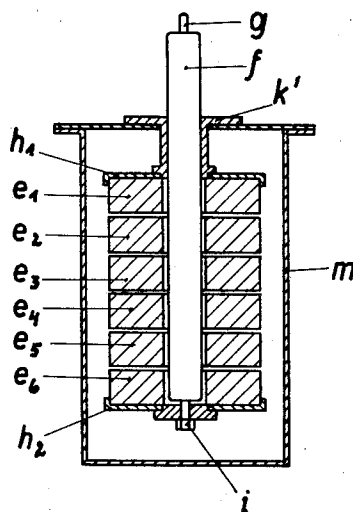


Fig. 7.

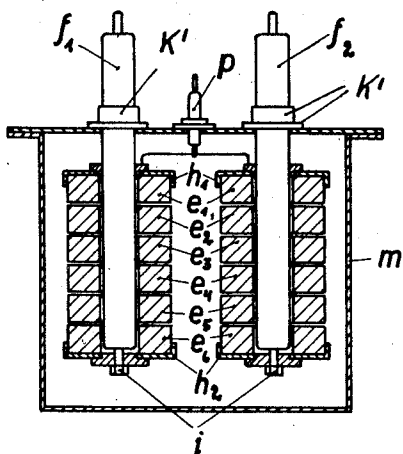


Fig. 8.

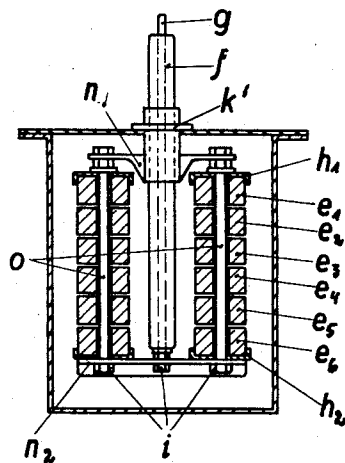
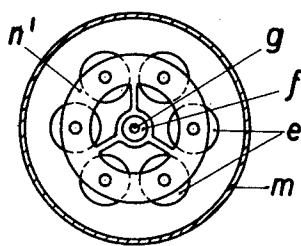


Fig. 9.



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Fig. 10.

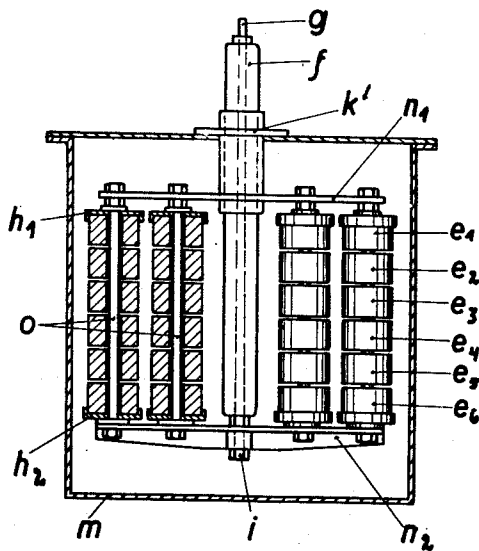


Fig. 12.

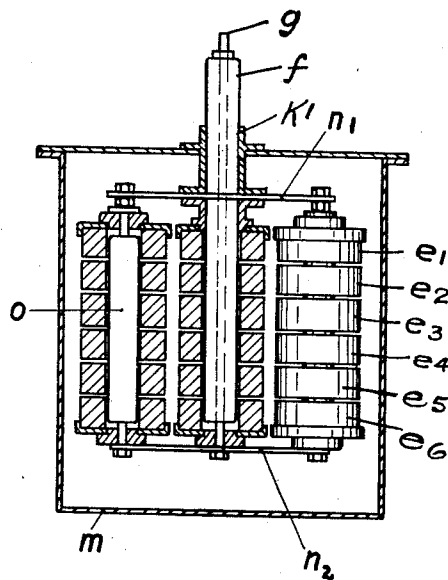


Fig. 11.

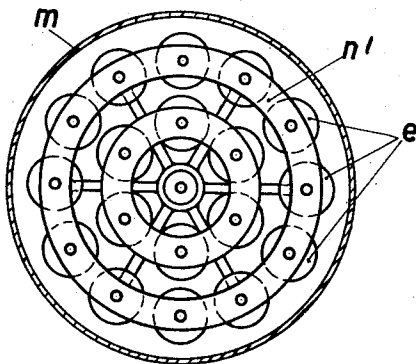


Fig. 13.

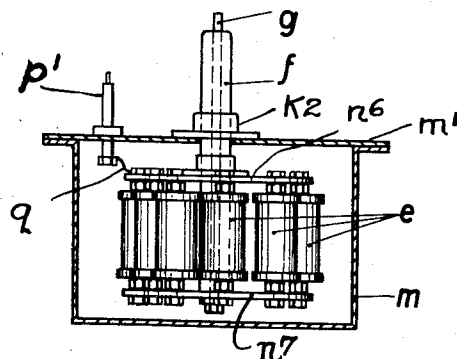
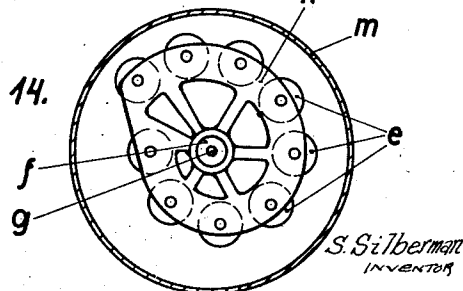


Fig. 14.



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UNITED STATES PATENT OFFICE

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HIGH TENSION CONDENSER

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Application October 9, 1931, Serial No. 567,892
In Germany July 25, 1930

8 Claims. (Cl. 175—41)

The invention relates to high tension condensers comprising a metal casing, one or more high tension leading-in conductors having insulating sleeves which project into the metal casing, and one or more condenser units enclosed in the metal casing, the space between the condenser unit or units and the casing being filled with an insulating substance or insulating oil. Hitherto, in condensers of this kind, the condenser units were arranged underneath the leading-in conductors and they were secured to the casing by means of separate supporting members consisting of solid insulating material. As the surface of these supporting members can easily cause leakage currents, it is necessary, more especially in the case of high voltages, to leave a great distance between the condenser units and the casing. Further, in an arrangement of this kind, the space next to the insulating sleeve of the leading-in conductor projecting into the metal casing, which space in the case of high tension currents may be large owing to the required length of the leading-in conductors, is not usefully utilized. This leads to dimensions of casing which are very great. Moreover a comparatively large amount of filling material or insulating oil as well as a large number of supporting members of solid insulating material are required. In consequence of these disadvantages the apparatus becomes large, heavy and expensive.

In the construction according to the present invention, it is possible to dispense with separate supporting members for securing the condenser units to the casing and usefully to utilize, for the production of capacity, the space around the insulating sleeve of the part of the high tension leading-in conductor which projects into the metal casing so that the dimension of the whole of the apparatus can be substantially reduced as compared with constructions as previously proposed.

According to the invention, the condenser units are arranged in the space next to the part of the insulating sleeve of the leading-in conductor which projects into the metal casing and is secured to the said projecting part. A suitable form of construction is obtained by using such condenser units which are formed by the winding of superposed alternate layers of metal foil and paper and which are provided with an opening along the axis of the winding. According to one arrangement, such a condenser unit is placed on the surface of the part of the insulating sleeve of the leading-in conductor which projects into

the metal casing and is secured to the said part of the insulating sleeve. According to another arrangement, a number of condenser units are arranged around the insulating sleeve leading-in conductor and supporting members are provided within the metal casing for securing the condenser units to the surface of the part of the insulating sleeve which projects into the metal casing, certain of the supporting members being secured to the insulating sleeve of the leading-in conductor and other of the supporting members being secured to the leading-in conductor, the said supporting members carrying bars of insulating materials, each of which passes through the central opening of a respective condenser unit. Use may be made, instead of such single condenser units, of a column or columns of such condenser units connected in series with one another.

The invention is illustrated, by way of example, in the accompanying drawings, in which:

Figure 1 shows a condenser unit which is partly unwound and which is provided with a central opening.

Fig. 2 illustrates a complete condenser unit which, according to the invention, is placed on the insulating sleeve of a high tension leading-in conductor and is secured to the said sleeve, the right-hand side of the figure showing the condenser unit in elevation and the left-hand side showing it in section.

Fig. 3 is a perspective view of a column composed of a number of condenser units connected in series with one another, which column is placed on the insulating sleeve of the leading-in conductor and is secured thereto.

Fig. 4 is a perspective view of an arrangement comprising three columns of condenser units connected in series, which columns are placed around a single insulating sleeve.

Fig. 5 shows diagrammatically the complete mounting of a single condenser unit in a metal casing surrounding the said unit.

Fig. 6 illustrates diagrammatically a longitudinal section of a form of construction as shown in Fig. 3.

Fig. 7 shows diagrammatically a longitudinal section of a construction of the character shown in Fig. 4 with the exception that it comprises two columns of condenser units connected in series with one another, each column being placed over an insulating sleeve.

Fig. 8 illustrates diagrammatically in sectional elevation a modification of the construction shown in Fig. 4, only two condenser columns being arranged around the leading-in conductor.

Fig. 9 shows diagrammatically a further modification of the construction shown in Figs. 4 and 8, more especially as regards the attachment of the condenser units, the construction comprising six columns of condenser units arranged around a leading-in conductor,

Figs. 10 and 11 show diagrammatically different views of further modifications of the constructions shown in Figs. 4, 8 and 9,

Fig. 12 is a section through a combination of the forms of construction illustrated in the previous figures, and

Figs. 13 and 14 show a special construction of several condenser units arranged around a leading-in conductor of the kind shown in Figs. 8 and 9.

Fig. 1 shows the manner of manufacture of a condenser unit which is wound and provided with a central opening. *a* and *c* are metal foils and *b* and *d* are the di-electric which consists of several paper layers impregnated with oil. The metal foil *a* projects at one side and the metal foil *c* at the opposite side beyond the oil-impregnated paper di-electric. When winding, an opening is left free in the axis, which opening is subsequently used for fixing the condenser unit.

Fig. 2 shows the completed condenser unit *e*, which is placed on the insulating sleeve *f* surrounding the leading-in conductor *g*. The parts of the metal foils which project on either side are respectively pressed together by the metal caps *h*₁ and *h*₂ and thereby caused to make good electric contact therewith. The metal cap *h*₂ is electrically connected with the conductor *g* by means of the screw-nut *i*, which serves for securing the condenser unit *e* to the insulating sleeve of the leading-in conductor. A bush *k* is in contact with the metal cap *h*₁ and serves electrically to connect the said metal cap with the other terminal of the circuit.

Fig. 3 shows in perspective the mounting of a condenser unit on the leading-in conductor. Three condenser units *e*₁, *e*₂ and *e*₃ are placed on the insulating sleeve *f* of the leading-in conductor. The electric connection between these condenser units is effected by the compression of the parts of the metal foils which project beyond the di-electric at the points *l*. At the two ends of the series-connected condenser units, the parts of the metal foils projecting beyond the di-electric are compressed by means of the metal caps *h*₁ and *h*₂ and thereby caused to make good contact therewith, *M* and *m*¹ are the metal casing and the cover thereof. *k*¹ is the holder of the leading-in conductor which is generally earthed.

Fig. 4 is a perspective view of a form of construction comprising three columns, each of which consists of six condenser units connected in series with one another, all being arranged around a single leading-in conductor. In this case the leading-in conductor does not pass through the central openings of the condenser units but separate supporting members *n*₁, *n*₂ are provided, the upper one of which is secured to the insulating sleeve of the leading-in conductor and the lower one of which is secured to the leading-in conductor. The individual columns are formed on rods *o* of rigid insulating material and the individual rods *o* are secured to the supporting members *n*₁, *n*₂. This arrangement enables a large number of columns connected in parallel with one another to be accommodated in a comparatively small space. The connection of the lower ends of the condenser columns with the conductor *g* is effected either by the supporting member *n*₂

being made metallic or by conducting cables being provided between the terminals and the conductor *g* and the condenser units in case the supporting member *n*₂ consists of insulating material. In the same way the upper ends of the condenser units can be connected in parallel. Thus, if the supporting member *n*₁ is made metallic it can be connected by using a downwardly extended holder *k*₁ with the metal condenser container or if the holder *k*₁ is not made sufficiently long to touch the supporting member *n*₁, the connection may be made by a cable conductor. If the supporting member *n*₁ consists of insulating material the various ends of the condenser columns must be connected together and with the metal casing by means of cables. The connection of the ends of the condenser columns with the casing can be effected by means of a guide provided on the casing cover *m*₁ and by a connecting cable.

The other figures illustrate various modifications of the invention diagrammatically.

Fig. 5 of the accompanying drawings illustrates the simplest form for carrying the invention into effect. The condenser unit *e* is placed with its central hole over the high tension leading-in insulation *f*. The metal cap *h*₂ projecting from the lower end of the condenser unit is conductively connected by means of a screw-nut *i* with the bolt *g* of the leading-in insulation carrying the high voltage, and the metal cap *h*₁ which projects at the upper end of the unit is conductively connected with the holder *k*₁ of the leading-in insulator, which holder is generally earthed.

Fig. 6 illustrates another form of construction according to the invention, in which use is made instead of a single unit *e*, of a column of similarly constructed condenser units *e*₁, *e*₂, *e*₃ etc., which are electrically connected in series with one another. This arrangement is more suitable for higher voltages than that illustrated in Figure 5.

A further form of construction according to the invention is illustrated in longitudinal section in Fig. 7. In the latter form of construction a number of, for instance 2, leading-in insulators *f*₁ and *f*₂ project into the interior of the condenser casing, each one supporting a column of the plurality of condenser units *e*₁, *e*₂, etc., connected in series with one another.

The arrangements hereinbefore referred to permit of various connections being effected, Fig. 7 illustrating the arrangement in which the electric centre of a condenser constituted by two columns connected in series with one another, is carried outside the casing *m* through a small separate leading-in insulator *p*. The said electric centre can thus be connected from the outside to any desired definite potentials, for instance earth potential.

A further constructional example is illustrated in Fig. 8. The high tension leading-in insulator carries two columns of condenser units connected in series with one another in the manner shown in perspective view Fig. 4.

The supporting members *n*₁, *n*₂ consists of conducting material. The holder *k*₁ is downwardly extended to such an extent that it can be brought into conductive connection with the supporting member *n*₁. By this means the separate condenser columns are connected in parallel.

Fig. 9 illustrates a support *n* which is suitable for the attachment of six columns.

The arrangement according to the invention may also be as shown in Fig. 10 in the form of

condenser units arranged in several concentric layers around the leading-in insulator. Fig. 11 illustrates a support suitable for the attachment of eighteen condenser units, six of which are arranged on an inner ring and the other twelve on an outer ring.

According to the invention the arrangement illustrated in Figs. 6, 8 or 9 may be combined together. In that case the arrangements are obtained, one of which is illustrated in Fig. 12 which shows three columns of condenser units arranged next to one another. In these arrangements the leading-in insulator passes through the openings of the condenser units which are connected in series with one another and are arranged in the form of a column, the said leading-in insulator serving at the same time for the attachment of further columns of condenser units by means of supports n and n_1 and rods o passing through the central openings of the condenser.

In the condensers shown in Figs. 10 and 12, condenser columns are connected in the same manner as in Fig. 8, that is, by using conducting supporting members n_1 and n_2 , and the downwardly extended holder k_1 .

According to the invention the condenser units may be secured to the leading-in insulator as shown in Figs. 13 and 14 by means of separate supports n_6 and n_7 in such a manner that they come to lie along a spiral around the leading-in insulator, the insulator being secured in the holder k_2 . In Fig. 13 the condensers are shown connected with a leading-in conductor p_1 by a cable g .

If desired, in the arrangements illustrated in Figs. 3, 4, and 6 to 10, use may be made of single condenser units instead of columns.

In Figures 13 and 14 single condenser units have been shown, it being of course understood that, instead, use may be made of columns composed of a number of condenser units.

What I claim is:

1. A high tension condenser comprising a metal casing, a high tension leading-in conductor having an insulating sleeve projecting into the metal casing, a plurality of condenser units enclosed in the metal casing, each one consisting of windings of superposed alternate layers of metal foil and paper and having a central axial opening, separate supporting members provided within the metal casing one of which is secured to the insulating sleeve of the leading-in conductor and one of which is secured to the leading-in conductor and rods of insulating material carried by the said supporting members, and respectively passing through the central axial openings in the said condenser units, for securing the condenser units to the said insulating sleeve of the leading-in conductor.

2. A high tension condenser comprising a metal casing, a high tension leading-in conductor having an insulating sleeve projecting into the metal casing, a plurality of columns of condenser units which are connected in series, each condenser unit consisting of windings of superposed alternate layers of metal foil and paper and having a central axial opening, separate supporting members which are provided within the metal casing one of which is secured to the insulating sleeve of the leading-in conductor and one of which is secured to the leading-in conductor and rods of insulating material carried by the said supporting members, and respectively passing through the central axial openings of the columns in the said condenser units connected in series with one an-

other for securing the condenser units to the said insulating sleeve of the leading-in conductor.

3. A high tension condenser comprising a metal casing, a high tension leading-in conductor having an insulating sleeve projecting into the metal casing, a plurality of condenser units enclosed in the metal casing and distributed concentrically around the leading-in conductor, each one consisting of windings of superposed alternate layers of metal foil and paper and having a central axial opening, separate supporting members provided within the metal casing one of which is secured to the insulating sleeve of the leading-in conductor and one of which is secured to the leading-in conductor, and rods of insulating material carried by the said supporting members and respectively passing through the central axial openings in the said concentrically distributed condenser units, for securing the condenser units to the said insulating sleeve of the leading-in conductor.

4. A high tension condenser comprising a metal casing, a high tension leading-in conductor having an insulating sleeve projecting into the metal casing, a plurality of columns of condenser units which are connected in series and distributed concentrically around the leading-in conductor, each condenser unit consisting of windings of superposed alternate layers of metal foil and paper and having a central axial opening, separate supporting members which are provided within the metal casing one of which is secured to the insulating sleeve of the leading-in conductor and one of which is secured to the leading-in conductor, and rods of insulating material carried by the said supporting members and respectively passing through the central axial openings of the columns in the said concentrically distributed condenser units connected in series with one another for securing the condenser units to the said insulating sleeve of the leading-in conductor.

5. A high tension condenser comprising a metal casing, a high tension leading-in conductor having an insulating sleeve projecting into the metal casing, a plurality of condenser units enclosed in the metal casing and distributed spirally around the leading-in conductor, each one consisting of windings of superposed alternate layers of metal foil and paper and having a central axial opening, separate supporting members provided within the metal casing one of which is secured to the insulating sleeve of the leading-in conductor and one of which is secured to the leading-in conductor and rods of insulating material carried by the said supporting members, and respectively passing through the central axial openings in the said spirally distributed condenser units, for securing the condenser units to the said insulating sleeve of the leading-in conductor.

6. A high tension condenser comprising a metal casing, a high tension leading-in conductor having an insulating sleeve projecting into the metal casing, a plurality of columns of condenser units which are connected in series and distributed spirally around the leading-in conductor, each condenser unit consisting of windings of superposed alternate layers of metal foil and paper and having a central axial opening, separate supporting members which are provided within the metal casing one of which is secured to the insulating sleeve of the leading-in conductor and one of which is secured to the leading-in conductor and rods of insulating material carried

by the said supporting members, and respectively passing through the central axial openings of the columns in the said spirally distributed condenser units connected in series with one another for securing the condenser units to the said insulating sleeve of the leading-in conductor.

5 7. A high tension condenser comprising a metal casing, a high tension leading-in conductor having an insulating sleeve projecting into the metal casing, a number of condenser units enclosed in the metal casing, each consisting of windings of superposed alternate layers of metal foil and paper and having a central axial opening, and one of the said units being placed over the outer surface of the insulating sleeve of the leading-in conductor, means for securing the said condenser unit to the said insulating sleeve, a number of supports provided within the metal casing, one of which is secured to the insulating sleeve of the leading-in conductor and one of which is secured to the leading-in conductor, and rods of insulating material secured to the said supports and passing through the central axial openings of the other condenser units, and by means of which these condenser units are secured to the

said insulating sleeve of the leading-in conductor.

8. A high tension condenser comprising a metal casing, a high tension leading-in conductor having an insulating sleeve projecting into the metal casing, a number of columns of condenser units connected in series and enclosed in the metal casing, each condenser unit consisting of windings of superposed alternate layers of metal foil and paper and having a central axial opening, and one of the said columns being placed over the outer surface of the insulating sleeve of the leading-in conductor, means for securing the said column to the said insulating sleeve, a number of supports provided within the metal casing, one of which is secured to the insulating sleeve of the leading-in conductor and one of which is secured to the leading-in conductor, and rods of insulating material secured to the said supports and passing through the central axial openings of the other columns of condenser units, and by means of which these columns are secured to the said insulating sleeve of the leading-in conductor.

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