

May 9, 1933.

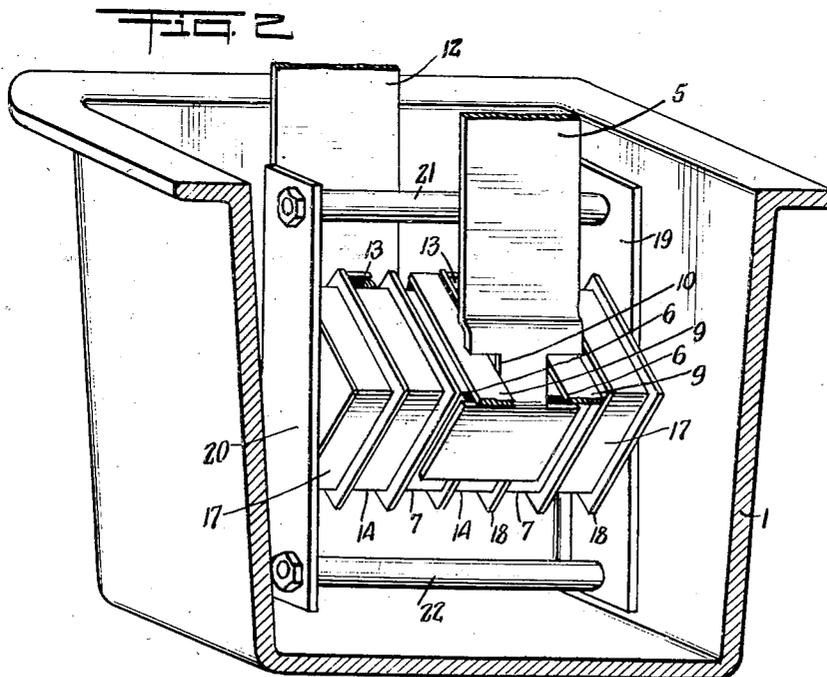
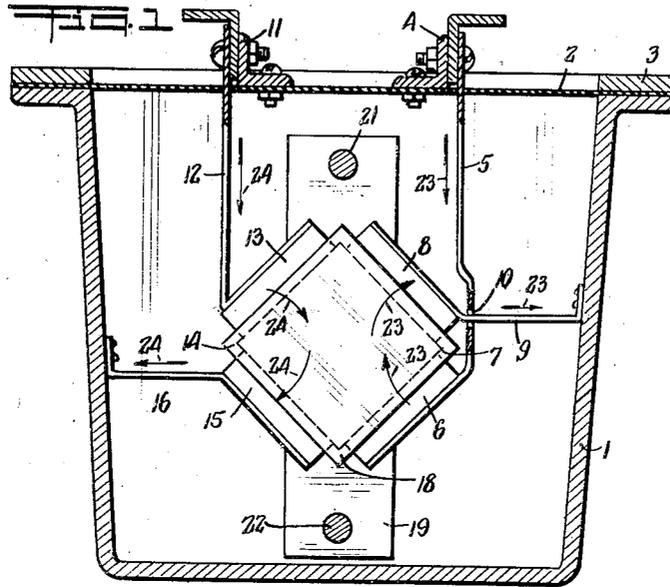
A. NYMAN

1,907,860

CONDENSER

Filed May 14, 1927

3 Sheets-Sheet 1



INVENTOR.
Alexander Nyman
BY *William F. Nickel*
ATTORNEY

May 9, 1933.

A. NYMAN

1,907,860

CONDENSER

Filed May 14, 1927

3 Sheets-Sheet 2

FIG. 3

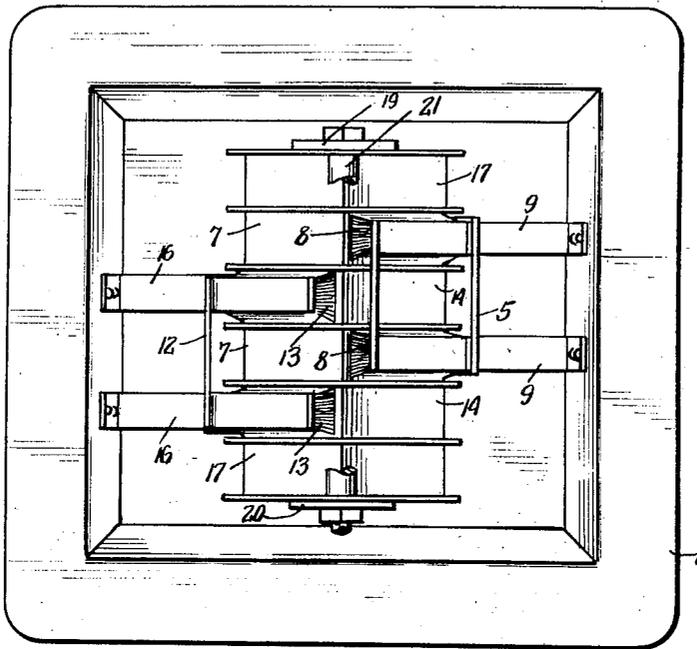
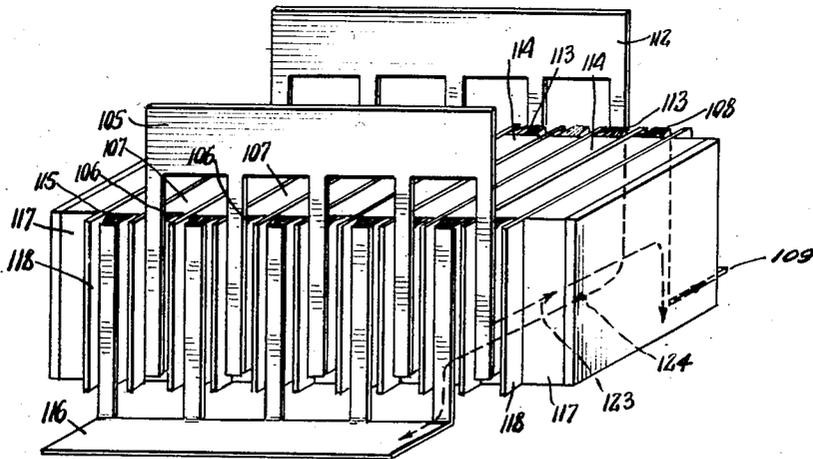


FIG. 4



INVENTOR
Alexander Nyman
BY
William F. Vickel
ATTORNEY

May 9, 1933.

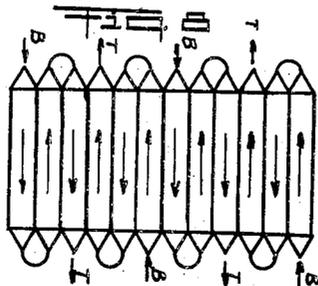
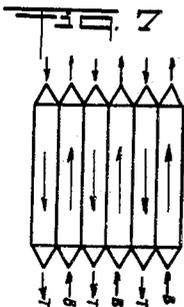
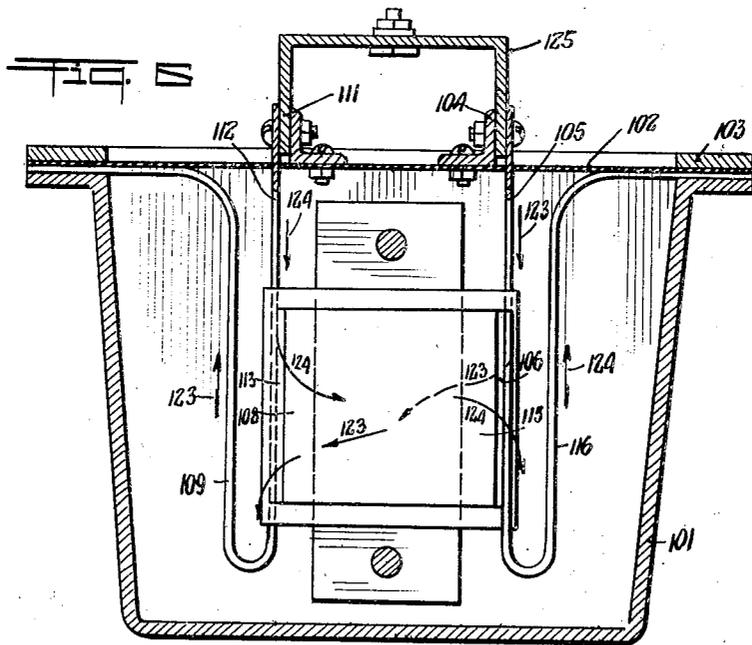
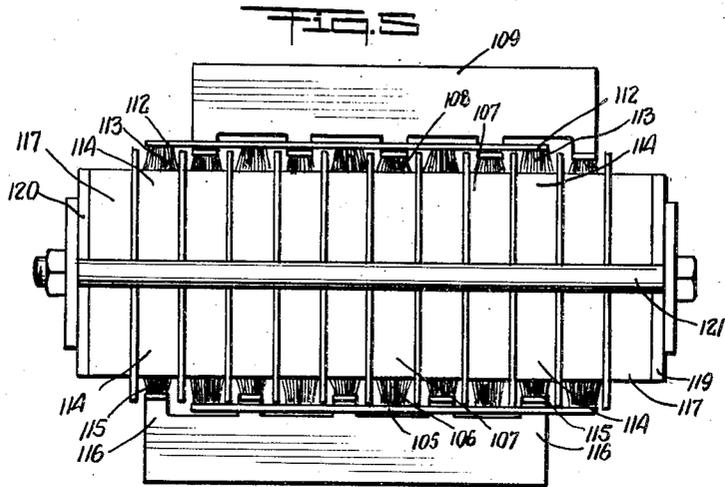
A. NYMAN

1,907,860

CONDENSER

Filed May 14, 1927

3 Sheets-Sheet 3



INVENTOR
Alexander Nyman
BY
William F. Nickel
ATTORNEY

UNITED STATES PATENT OFFICE

ALEXANDER NYMAN, OF DOBBS FERRY, NEW YORK, ASSIGNOR TO DUBILIER CONDENSER CORPORATION, OF NEW YORK, N. Y., A CORPORATION OF DELAWARE

CONDENSER

Application filed May 14, 1927. Serial No. 191,373.

This invention relates to electrical condensers, particularly condensers for use in circuits such as those occurring in radio apparatus.

5 An object is to produce a condenser having the electric currents flowing in such wise that adjacent portions of the condenser will carry currents in opposite or at least divergent directions. The result is that any
10 magnetic or electrostatic field resulting from the flow of current at one part will be neutralized by opposite or divergent currents in adjacent parts. Thus losses are reduced and the efficiency of the condenser greatly
15 increased.

Other objects and advantages are set forth in the following description, taken with the drawings, which show two modifications of a preferred embodiment of my invention.
20 But this disclosure is illustrative only, and I may vary the details of shape, size and arrangement of parts to the full extent permitted by the scope and meaning of the appended claims, in which the novelty of the
25 invention is expressed.

In the drawings the same reference numerals indicate the same elements in all figures showing the same modification.

30 Figure 1 is an end elevation in cross section of one modification of the condenser.

Figure 2 is a perspective partly in cross section through from the right hand side with respect to Figure 1,

35 Figure 3 is a top plan view of the modification shown in Figure 1, with closure omitted,

Figure 4 is a perspective view of the inner assemblage of another modification,

40 Figure 5 is a plan view of what is shown in Figure 4,

Figure 6 is an end elevation in cross section of the complete condenser that uses the assemblage of Figures 4 and 5;

45 Figure 7 is a diagram showing the flow of current with respect to a condenser with terminals arranged to accommodate low voltage; and

50 Figure 8 is a diagram showing the flow of current with portions of the condenser

connected in series to take care of currents of higher voltage.

During the early stages of radio development, one of the first improvements in electric condensers and particularly mica condensers was that of holding the laminations of dielectric and conducting material under pressure by some sort of a clamp. This improvement kept the capacity of the condenser constant and very greatly reduced the heating of the condenser by the currents of higher frequency and appreciably increased the capacity of the condenser. Then still higher frequencies came into vogue ranging well over one million cycles per second and serious heating again took place even in the improved condensers provided with clamps. An important additional improvement introduced at that time was that of placing the terminals on one side of the clamp as described and claimed in my co-pending application 94,856, which improvement gave some relief. This feature of having the current enter and leave from the same side of the clamp instead of proceeding right on through, cut down eddy currents in the metal comprising the clamp due to magnetic flux from the high frequency currents. Then after lengthy and difficult experimentation it was realized that merely eliminating magnetic effects through the clamp was not enough but that since every magnetic field was accompanied by an electrostatic field these electrostatic fields were heating up the dielectric laminations and also layers of insulation that were necessarily placed between the laminated stack and the material of the clamp. Such considerations lead to the present invention which consists in "sandwiching" the sections. That is, arranging alternate sections so that the current travels through them in opposing or diverse directions rather than in parallel directions. The magnetic field was thereby completely eliminated and immediate and decided relief resulted, inasmuch as the heating effects were reduced to one tenth or less of what they had been previously. This not only permitted the handling of modern high frequency currents

but also permitted the making of condensers in substantial sizes to take care of these currents in large amperages as required in high power sending stations.

5 The form of the invention shown in Figures 1, 2 and 3 comprises a condenser enclosed in a casing or shell 1, which is preferably a metal casting, and is provided with a cover or lid 2 of insulating material such
10 as mica. This lid is held in place by a detachable flange 3 secured in any convenient way. The condenser is provided with an outside terminal 4 to which is attached a terminal lead 5, which is in contact with
15 sheets of metal foil 6 that project out to the right as seen in Figure 1 from stacks or units 7, composed of alternate layers of metal foil and dielectric material. These units or sections 7 have a second set of
20 sheets of metal foil 8, to the projecting ends of which is attached a ground lead 9, which is fast to the casing 1. It should be noted that the leads 5 and 9 cross each other at intersection point 10 but do not make contact
25 thereat.

The condenser is likewise provided with an outside terminal 11 and a terminal lead 12 contacting with metal foil sheets 13, which project out from the stacks or sections
30 14 at the left as viewed in Figure 1. These units 14 have another set of metal foil sheets 15 to the ends of which is attached ground lead 16, which is also secured to the casing 1. There is no crossing
35 between leads 12 and 16 corresponding to the intersection 10 at the other side of the condenser. The sections 7 alternate with the sections 14 and all the sections are disposed between end blocks 17. The blocks
40 17, which in the drawings appear very much like the units 7 and 14, are of insulating material. The plates 18, next the blocks 17, and between the sections 7 and 14, and the sections and blocks 17, best shown in Figure 2, are also of insulating material, and
45 serve as separators. The entire series of units is kept under compression by a clamp comprising bars or plates 19 and 20 which are secured together by bolts 21 and 22.

50 This whole inside assemblage is positioned within the casing by means of leads 5 and 12, and ground leads 9 and 16.

The second modification, shown in Figures 4, 5 and 6, comprising a condenser enclosed in a casing 101 which is provided
55 with an insulating lid 102, which is held in place as before by a flange 103. This condenser is provided with an outside terminal 104 to which is attached a terminal
60 lead 105 which contacts with the ends of sheets of metal foil 106 that project from units or sections 107, composed of alternate layers of metal foil and dielectric. These units 107 have a second set of metal foil
65 sheets 108 which project at the opposite side

of the units. The sheets 108 contact with lead 109 which engages the top of the casing 1. The foil sheets are clearly shown in Figures 4 and 5, but are concealed by each other and by other parts in Figure 6.

70 The second modification is also provided with an outside terminal 111 and a terminal lead 112 contacting with sheets of metal foil 113, the ends of which project out from one end of the units 114. These
75 units 114 have another set of sheets of metal foil 115, the ends of which project at the other end of the condenser. The sheets 115 are attached to ground lead 116, which is carried upward and secured to the casing
80 101 at its upper edge. As before, the sections 114 alternate with the sections 107. The blocks 117 are not active units but are of insulating material, and correspond to the blocks 17 above-described. The plates
85 118, somewhat larger in area than the units, are also of insulating material, and correspond to the plates 18, above-mentioned. The entire series of units are kept under compression by a clamp including plates or
90 bars 119 and 120 which are secured together by bolts 121 and 122. The weight of this inside assemblage is supported by the leads 105 and 112 and the surrounding wax, for after assembling, the casing is filled with
95 wax.

The operation of the first described modification of the condenser is as follows:

Looking at Figure 1, it will be seen that if terminals 4 and 11 are connected in parallel to a common source of current, the current will be split, part of it having the direction indicated by the series of arrows
100 23 with respect to elements 5, 6, 7, 8 and 9, and the other half of the current will take the direction indicated by the series of arrows marked 24 with respect to the elements 12, 13, 14, 15 and 16. The casing 1 is the grounded terminal. Looking at the center of Figure 1, it will be noted that the general direction of these two currents is opposite, so that whatever magnetic field is built up by one current is exactly neutralized by the other current.

115 The operation of the second modification, shown in Figures 4, 5 and 6, is as follows:

The current splits and passes through the two leads 105 and 112 to the terminals of the sheets of foil at the opposite sides of the assemblage of stacks, just as in the first modification. From this point a difference
120 will be noted. The direction of the current is not out again at the same side, but right through the condenser, as particularly indicated by the broken lines in Figure 4; and the direction as to the sections 107 is parallel but opposite with respect to the direction for the sections 114. Also the current in the ground lead 116 travels exactly
125 opposite to the direction of the current in
130

the terminal lead 105, while the current in lead 109 travels opposite to the direction of the current in lead 112. The direction of the current as regards lead 105, sections 107 and lead 109, is indicated by arrows 123; and for lead 112, sections 114, and lead 116 by arrows 124. There is an important difference in the two modifications. Looking at Figures 4 and 5, it will be noted that any given unit, such as 114, has its two foil terminals projecting out from opposite edges. In the first modification, any given unit, such as 14, has its foil terminals 13 and 15 projecting out at right angles to each other. The result is that in the second modification the current travels in approximately straight lines with the directions opposite as regards adjacent units, while in the first modification the currents have a direction something like a quarter of a circle, and as respects adjacent units are not exactly opposite, although they are decidedly not travelling in the same direction. They at least travel at right angles or transversely to each other, and usually cross in paths more divergent than a right angle. The contrast is made evident by the sets of arrows 23 and 24, shown in Figure 1, when compared with the sets of arrows 123 and 124, shown in Figure 6.

The diagram, Figure 7, shows a series of units which are all connected in parallel and the current will not only travel as to these units in parallel directions, but in the same direction if the principle of this invention were not applied. But since the terminals are arranged as called for by this specification, the adjacent currents are travelling in exactly opposite directions and are still parallel.

The diagram, Fig. 8, shows four groups of units, the four groups being connected in parallel, while the three units in each group are in series. Within each group of three units, the shortest and most convenient connections necessarily make the currents as regards adjacent units travel opposite, so that the objects of this invention might have been attained heretofore within such groups quite by accident, but when the four groups are connected in parallel, it will be noted that the connections are reversed in each adjacent group so that the currents as to adjacent units of different groups have their direction of travel opposite with respect to each other.

Referring to Figures 1 and 6, outside terminals 4 and 11, and also 104 and 111 will be noted. These terminals are so located that the inside leads, such as 5 and 12, are placed "outside" the terminals 4 and 11, that is, lead 5 is placed on that side of terminal 4 which is farthest removed from terminal 11, and lead 12 is placed on that side of 11 which is farthest removed from terminal 4.

The reason for this is that with such high frequency transient currents, the current travels on the outside of any given wire or hollow tube, or with two masses of metal, such as terminals 4 and 11, the current will travel on the outer side of those two masses regarding them as one structure or hollow unit. If these terminals were carelessly located so that leads 5 and 12 went up inside or between terminals 4 and 11, then the current might jump across between the contacts and surfaces and take a path outside these two masses of metal just as it takes a path on the outside of a hollow tube, and the crossing of such surfaces and contacts results in heating effects.

In practice the terminals 104 and 111 are preferably connected by a bridge of metal indicated at 125 having means shown at 126 for fastening a single conductor thereto. The same expedient may be followed with reference to the terminals 4 and 11 of the condenser of Figures 1, 2 and 3.

Of course the current does not pass through the sections 7 and 14 or 107 and 114 in the same sense as the current passes through a continuous conductor because part of the sheets of foil of each section are connected to one end of the operating circuit and the remainder to the other end of the circuit and the two groups of foil of each section change rapidly from positive to negative and vice versa by turns as the current, which is alternating current, reverses itself in each cycle. But the directions of the current which are opposite as above described remain opposite with each reversal of current, which, of course, takes place simultaneously in every part; and by this method of controlling the flow of current into the leads and the sheets of foil of the various sections and out again when the current reverses itself, all of the advantages desired are obtained.

The heating effects are not limited to those resulting from eddy currents in the laminations of foil and other metal parts due to the magnetic field. A magnetic field is always accompanied by an electrostatic field whose lines of force run at right angles to the lines of the magnetic field and this electrostatic field becomes appreciable at radio frequency. This field rapidly fluctuating through the insulation creates heat and therefore results in loss. The arrangement of the paths of current in nearby groups of metal foil in opposing directions so as to neutralize the magnetic fields of the several groups must necessarily neutralize the electrostatic fields and eliminate heating losses in the layers of dielectric and in other adjacent pieces of insulation.

Comparison of the first modification, shown in Fig. 1, with the second modification, shown in Fig. 6, may be facilitated if

the assemblage of sections of each modification is thought of as being divided into two halves by a vertical plane passing through the tension bolts 21 of the clamp, this plane being at right angles to the plane of the paper in both Figs. 1 and 6. It will then be evident that any given unit or section in Fig. 1 has both of its terminals extending out from the same half or side of the assemblage or group of sections, while alternate sections have their terminals projecting from opposite halves or sides of the group of sections taken as a whole.

The alternate sections in Figure 6 will, on the other hand, have their terminals at the ends projecting out at different or opposite sides of the group of assemblage. Hence the current in alternate sections will flow in parallel paths, but owing to the mode of connection of the terminal leads the directions will be opposite.

That is, in Figures 1, 2 and 3 the alternate sections 7 are disposed transversely of the remaining sections 14, but in Figures 4, 5 and 6 the alternate sections 107 are not transverse with respect to the sections 114 but the corresponding axes of all the sections are parallel.

Having described my invention, what I believe to be new and desire to secure and protect by Letters Patent of the United States, is:—

1. A condenser comprising sections with each section containing a set of conducting elements having projecting ends adapted to be grounded and a set of conducting elements having projecting ends adapted to be connected to a line conductor, with each alternate section disposed so that its ends project in a direction different from the corresponding ends of the remaining sections, and terminal leads that divide so as to connect with the ends of each alternate section.

2. An electric condenser comprising a group of sections, a compression abutment at each end of the group, tension rods connecting the two abutments and located above and below the group, conducting elements projecting from each section at the sides of the group, duplicate potential leads at each side of the group attached to alternate sections in the group and duplicate ground leads at each side of the group attached to alternate sections.

3. An electric condenser comprising an assemblage of condenser sections and terminal leads for the sections, each section being provided with conductive elements projecting from the section at opposite sides of the assemblage, and each of said terminal leads having branches so as to connect with the conductive elements on both sides of said assemblage, said connections being arranged so that adjacent condenser sections contact with different branches of the same termi-

nal on opposite sides of said assemblage to cause the current in adjacent sections to flow in opposite directions.

4. An electric condenser comprising an assemblage of condenser sections and terminal leads for the sections, each section being provided with conductive elements projecting from the section at the same side of the assemblage but in different directions from said side, and each of said terminal leads having branches so as to connect with the conductive elements on both sides of said assemblage, said connections being arranged so that adjacent condenser sections contact with different branches of the same terminal on opposite sides of said assemblage to cause the current in adjacent sections to flow in directions transverse with respect to each other.

5. A condenser comprising a stack of contiguous sections alternately arranged with respect to each other, and forming two groups with respect to their electrical connections to the condenser terminals, the sections of the first group having their armatures of one polarity, and the sections of the second group having their armatures of the opposite polarity, extending from a given side of the stack, means for connecting the said armatures of the first group to one of the condenser terminals and means for connecting the said armatures of the second group to the other condenser terminal, the sections having their remaining armatures extending from another side of the stack, means for connecting the remaining armatures of the second group to the first-named condenser terminal, and means for connecting the remaining armatures of the first group to the other condenser terminal, whereby the instantaneous direction of current flow through any one of the sections is opposite to that of the current flow in the adjacent sections.

6. A condenser comprising a stack of contiguous stack sections alternately arranged with respect to each other, and forming two groups with respect to their electrical connections to the condenser terminals, the sections of the first group having their armatures of one polarity, and the sections of the second group having their armatures of the opposite polarity, extending from a given side of the stack, a first conductor connecting the said armatures of the first group to one of the condenser terminals and a second conductor connecting the armatures of the second group to the other condenser terminal, the sections having their remaining armatures extending from the opposite side of the stack, a third conductor connecting the remaining armatures of the second group to the first-named condenser terminal, and a fourth conductor connecting the remaining armatures of the first group to the other

condenser terminal, whereby the instantaneous direction of current flow through any one of the sections is opposite to that of the current flow in the adjacent sections.

5 7. A condenser adapted for use with radio frequency currents, comprising a plurality of contiguous groups of condenser sections, each group comprising a plurality of sections connected in series, said groups being
10 connected in parallel to the condenser terminals of opposite polarity and the sections being connected in each group so that, at any instant, the current flowing in any one of the sections is opposite in direction to the
15 current flowing in the sections adjacent thereto, whereby the fields of the opposing currents neutralize each other.

8. An electrical condenser comprising a group of contiguous condenser sections
20 forming a condenser stack, each section comprising interposed flat sheets of foil and insulation with the foils of opposite polarity projecting therefrom in different directions, the sections being disposed in the stack
25 with the foil projections of like polarity in adjacent sections projecting from the stack in opposite directions, and terminals for said stack, each terminal comprising two spaced-apart portions extending along opposite
30 sides of the stack and connected to the respective groups of foil projections of like polarity.

9. A condenser adapted for use with radio frequency currents, comprising a plurality of
35 contiguous condenser sections connected in parallel to terminals of opposite polarity, each of said sections being so positioned in the stack relative to the sections immediately adjacent thereto and having its armatures
40 so connected to the respective terminals that, at any instant, the direction of the current in any one of the sections is opposite to the direction of the currents in said adjacent sections, whereby the fields of the opposing
45 currents substantially neutralize each other.

In testimony whereof I affix my signature.

ALEXANDER NYMAN.

50

55

60

65