Nov. 20, 1923 1,474,486

B. MACPHERSON

ELECTRICAL CONDENSER

Filed June 3, 1919

Fig. 1.

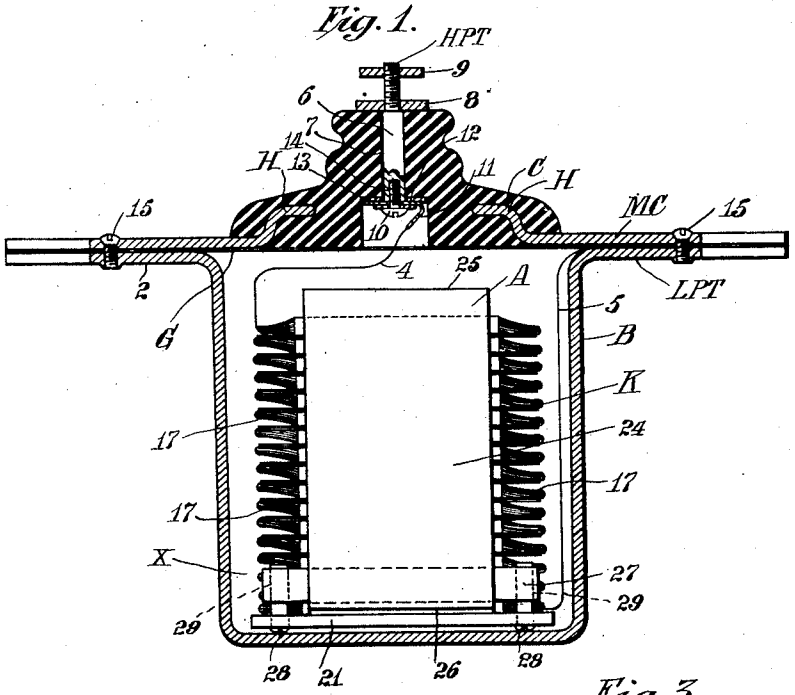


Fig. 3.

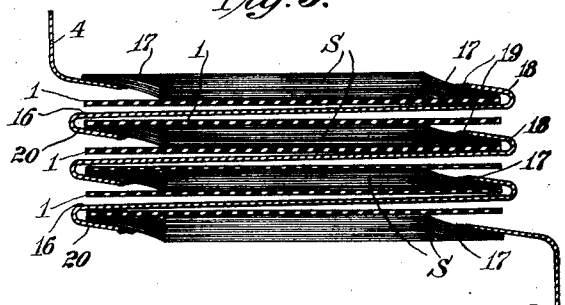


Fig. 2.

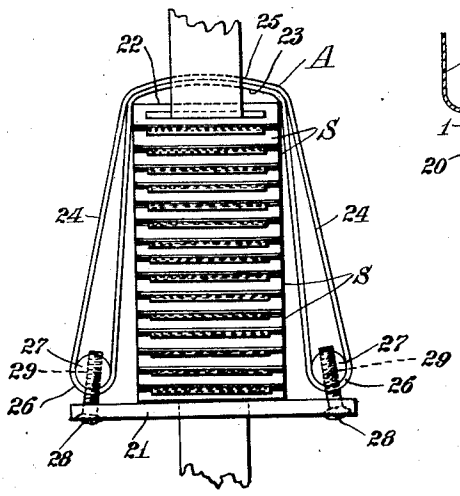
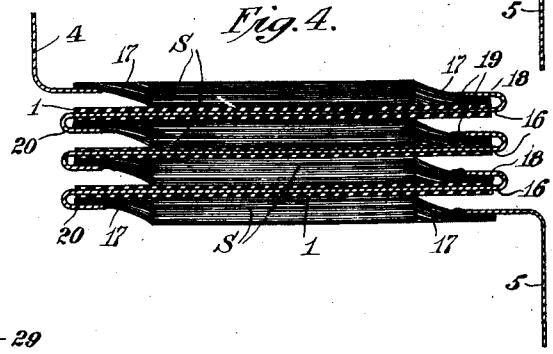


Fig. 4.



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UNITED STATES PATENT OFFICE.

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ELECTRICAL CONDENSER.

Application filed June 3, 1919. Serial No. 301,498.

To all whom it may concern:

Be it known that I, BYRON MACPHERSON, a citizen of the United States, and a resident of Roxbury, Massachusetts, have invented certain new and useful Improvements in Electrical Condensers, the principles of which are set forth in the following specification and accompanying drawing, which disclose the form of the invention which I now consider to be the best of the various forms in which the principles of the invention may be embodied.

This invention relates to improvements in electrical condensers of the plate or sheet type, especially of the type wherein the condenser is divided into sections and the sections connected in series for high potential service and the invention consists of certain improvements in the condenser stack and the means for connecting the sections together.

Broadly the object of this invention is to provide an improved condenser adapted for high potential service.

In particular the object of the invention is to provide a connection or strip between the sections of the condenser which insures a better distribution of potential between adjacent sections, which prevents an accumulation of heat within the condenser and which allows ready inspection.

In the drawing Fig. 1 is a side elevation of the condenser with parts (the casing) in section.

Fig. 2 is an end elevation, the casing being omitted.

Fig. 3 is an elevation on an enlarged scale showing the details of construction of the condenser stack, the sections being separated or spread for inspection, and

Fig. 4 is an elevation similar to that of Fig. 3 and showing the relative position of the parts of the stack when clamped together.

The space X shown around the stack K (Fig. 1) and its clamp A in the wax protector or casing B is intended to illustrate the wax casing or coating around the stack for the purpose of preventing brush discharges and excluding moisture and air, and also preferably around the clamp. This is preferably a mass of wax cast in protector B as a mold and completely filling space X; but it is not necessary that the wax coating completely fill space X, or surround clamp A and it may be no more than a thin or surface coating provided that it excludes moisture and air from the interior of the stack and assists in preventing brush discharges.

In the type of condenser on which this invention is an improvement, the condenser consists of a stack of plates or sheets, this stack being adapted for high potential service by being divided into sections which are electrically connected together in series as will be more fully described hereinafter.

The sheets, as usual, consist of successively located conductors and insulators. In the present condenser such insulating and conducting sheets may be of any desired material but I use metal foil (as lead) for the conducting sheets and mica for the insulating sheets and my condenser is therefore known in the trade as a mica condenser, or specifically, a high potential mica condenser for use in radio communication.

A desirable feature of such a condenser is a minimum volume but the high potential developed makes this a difficult problem. The same is true in respect of exposing a minimum of the conducting parts which are at high potential. Other problems have arisen in connection with the importance of the construction whereby the condenser stack is most desirably held under compression and kept permanently dry and free of air inside the stack and whereby brush discharges are to be prevented.

In condensers of the type built up of series connected sections of equal capacity the potential difference across the total condenser divides equally across the several sections. If the several sections are arranged in a compact stack and the connections are of the usual type in which the terminals or ends of the sections are alternately connected in pairs, a potential difference of twice that between the ends of a section exists between adjacent connections and between unconnected adjacent ends of adjacent sections. This results in a brush discharge between said unconnected ends and between said connections unless a large quantity of insulation is provided between them. I have provided a system of connection between adjacent sections for limiting the difference of potential between the adjacent ends of adjacent sections to a value equal to the potential difference between the ends of any one section.

In condensers of the type carrying a heavy load, as condenser losses increase markedly with increase in temperature, I have provided means hereinafter described and constituting a feature of the present invention to cause radiation and conduction of heat from the condenser and especially from the interior of the condenser.

Another difficulty encountered in condensers of the types now in use is that if one section breaks down either the whole condenser is rendered useless or at least the adjacent sections. Furthermore with such prior constructions it is very difficult to properly inspect the same and to make replacements. For instance, in removing bad sections the other sections are often spoiled.

Another defect in construction now in use resides in the fact that mistakes in connecting the sections, short circuiting the sections, are common.

These various problems have been solved and such defects overcome in a practical manner by this invention wherein the construction has been developed around my conception of connecting the sections of the stack in series, and particularly in connection with the arrangement for the connection of the sections as more clearly shown in Figs. 3 and 4.

In the embodiment of the invention here illustrated the terminals at opposite ends of the stack are of opposite potential, one low and one high, but the invention is applicable to other arrangements. One end of the stack is connected to a high potential terminal H P T, the opposite end of the stack being connected to a low potential terminal L P T. The expressions "high potential terminal" and "low potential terminal" are, of course, only relative terms and the actual high and low potential points depend entirely upon the condition of the circuit in which the condenser may be used. As illustrated in Figs. 1 and 2 the high potential terminal H P T is connected by lead 4 to one end of the stack K, the terminal H P T being itself mounted in the insulating cover C. The low potential terminal L P T may be the metal part of the cover M C (Fig. 1) or the wax protector B if that be of metal. In any case terminal L P T may be connected by lead 5 with the section S at the opposite end of the stack. The specific high potential terminal is merely illustrated and described for the purpose of showing the application of the stack to the casing and constitutes no part of the present invention. The specific casing and terminal is more fully shown and described in an application of Greenleaf Whittier Pickard Serial Number 292,126, filed April 23, 1919.

The particular condenser here illustrated and described as an embodiment of the invention is a type of a standard capacity 0.004 micro-farad condenser in extensive use with transmitters in radio communication. In this form each section S consists of the size, number and thickness of sheets which will give the condenser a capacity of 0.004 micro-farad altho it is to be understood that the stack may have any desirable capacity and comprise any number of sections and still be within the scope of this invention.

Of course, the stack K of this condenser, like any condenser stack of sheets, requires initial treatment during manufacture for the purpose of removing internal air and moisture and consolidating the stack of sheets before being covered with the coating of wax X, (Fig. 1) which thereafter is to keep out the air and moisture. Any of the various well known methods may be used for this treatment which usually includes immersion in molten wax, in or out of vacuo, and a compression or variation of the compression of the stack. For this purpose the sections are maintained in clamping position by any suitable clamp preferably that which accompanies the stack and maintains it in clamping position.

The stack and the clamp as in Fig. 2 are assumed to have been properly treated as above, and in proper condition of clamping pressure and are ready to be surrounded by their casing of wax X.

The wax protector B is so called because it may serve initially as a mold for the wax casing X when the latter fills container B, yet thereafter protector B remains as a permanent part of the assembly for the purpose of protecting the wax casing which it does whether the casing be merely a coating around the stack K or a thick mass entirely filling protector B.

In preparation for the casting of the wax in receptacle B the stack K and clamp A in place around it are inserted in receptacle B as the mold and protector and secured therein in any suitable manner.

The wax protector B may be of any desired material or shape because it has no necessary mechanical or electrical co-operation with the condenser stack. Thus it may consist of any simple wood or fiber box of any size or shape, if desired. In fact as the stack K and clamp A constitute the complete operative condenser, they may be used without casing or coating of wax, but, of course, it is extremely advantageous to provide a wax protector and also to have it of metal as the most practical form of condenser. I prefer that the wax protector B be of metal as aluminum as a simple and economical construction. Aluminum is light and cheap and easily shaped, but any other metal may be used, such as tin.

At the time that the stack and clamp are cast in B the high potential lead and the low potential lead are left projecting above

the wax, in preparation for the application of the condenser cover.

After the wax in protector B has been cooled and solidified, the top or cover may be applied upon gasket G interposed for water tightness. The low potential lead 5 may be laid either over or under the gasket G. Then the cover and protector B are secured together as in Fig. 1 to complete the assembly.

The low potential lead 5 may be a copper strip the upper end of which is pinched between metal cover M C and the flange 2 of metal casing B and the lower end of which is secured to one end of the lowermost section.

The cover may have the construction shown because it plays no part in compressing the stack, a complete and independent clamp A being provided for the stack. The central part C is of cheap insulating material such as electrose or the like, molded as shown about the anchors H (Fig. 1) which project radially inward from the metal part M C of the cover. The central insulating part C of the cover is molded with an upper hole and lower recess shown for the reception of the terminal H P T and its associate parts. If desired the entire cover may be of insulating material.

Before the cover is applied, the high potential lead 4 left projecting up above the wax casing X is connected up thru gasket G to the terminal H P T. The means for making such connection is designed to obviate the necessity of using a long lead. This terminal consists of a piece of square brass stock 6 which fits in the square hole 7 shown in molded cover C. The upper end of the terminal H P T projecting above cover C is turned to be round and is threaded to receive nuts 8 and 9. The lower end of this terminal is tapped to receive a screw 10. Before cover C is put in place, lead 4, (of copper braid or strip) projecting above the wax casing X which is flush with the top of receptacle B, is soldered to a lug or connector 11. At this time terminal H P T is not in place in the cover. The screw 10 is then put thru a washer 12, then thru lug 11 and then a gasket 13 is placed on top of lug 11. Next screw 10 is screwed into the tapped hole 14 in the bottom of terminal H P T, the latter then being pushed up thru the square hole in the cover. The metal part M C of the cover is fastened in place over gasket G by screws 15. Then lower nut 8 is applied to the top of terminal H P T to draw it up tight, which compresses gasket 13 between lug 11 and the top of the recess in the cover, thereby sealing the terminal against ingress of moisture. Upper nut 9 is for clamping any desired connection to H P T.

Figs. 3 and 4 show (with my improvements in detail) the stack divided into sections S by placing insulating sheets between them and connecting the sections in series to adapt the stack for high potential service. Here, as heretofore, each section S comprises a plurality of alternately disposed sheets of mica and foil, the mica being of larger area than the foil sheets. For the sake of clearness the correct proportion of the parts are not shown in Figs. 3 and 4.

Each pair of adjacent sections are separated from each other by two insulating sheets or separators 1 which may be of mica and which are interposed between such sections and upon opposite sides of a conducting sheet or connector 16 which may be of any suitable material which is a ready conductor of electricity and heat, as, for instance, copper, and which extends between the sections parallel therewith. These conducting sheets have preferably a substantial tensile strength at least greater than that of the lead or tin foil constituting the parts of each section and also some flexibility. From each end of each section S there extends a bunch 17 of foil in that section, in order to permit the sections to be connected together. These bunches of foil are fragile and easily torn and broken especially when covered with hard wax, and heretofore it has been found that in assembling the sections it oftentimes happens that the condenser was damaged so that it could not be used. At least great care had to be exercised in assembling the same. This difficulty is obviated by connecting the bunch 17 at a given end of one section S with the bunch at the opposite end of an adjacent section S preferably by means of the connecting sheet 16. One end 18 of sheet 16 is doubled back around the foil bunch at one end of a section and around the adjacent end of an insulator 1 in the manner shown in Fig. 3 and soldered to the remote or outer side of the bunch as indicated at 19.

The opposite end 20 of connector 16 is similarly folded around the foil bunch at the opposite end of the adjacent section and around the adjacent insulator 1 and soldered to the outer or remote portion of that bunch and so on thru the stack, connecting all the sections S together in series.

It should be noticed, referring to Figs. 3 and 4 that the portion of the connecting strips 16 adjacent to the inner portions of the foil bunches are unattached thereto, thereby allowing play and a large degree of flexibility. By the present construction, the sheets 1 can be arranged symmetrically between the sections and upon opposite sides of the conducting sheets 16, so that their ends project equal distances from opposite ends of the sections but not beyond the extreme outer portions of the connections 16 between the sections.

The clamp A for clamping the several

sections, connectors and separators together holds the parts in close contact under pressure independently of the cover. This clamp comprises a metallic block or base plate 21 on which stack K rests. This base plate may be of any suitable material and is secured in any suitable manner to the bottom of the casing. To the top of the stack is applied a pressure block or plate 22 having an upper convex surface 23. A flexible loop or band 24 of insulating material preferably of fiber such as fish paper, which is very durable and does not stretch, connects the blocks 21 and 22 to clamp the same against the ends of the stack. This loop preferably comprises several layers or plies of such fish paper. The intermediate portion 25 extends over the block 22 engaging the convex surface thereof and the closed ends 26 of the loop extend on opposite sides of the stack and are connected to parallel clamping bars 27 upon the base plate on opposite sides of the stack K, the closed ends of the loop extending below the bars 27 and the bars being interposed between the plies of the loop. These clamping bars 27 are fastened or connected to the base plate 21 by means of screws 28 extending thru the base plate and threaded thru holes 29 in the bars. By adjusting the screws the loop 24 is drawn upon pressure block 22 tightly clamping the parts of the stack together between the blocks. The band 24 is of substantial width, the sides facing the opposite sides of the several sections of the stack K, and constitute an insulating barrier between the stack and the adjacent walls of the casing B, the clamp of course being imbedded in wax. The fish paper band is preferably treated with armalac to prevent it from being affected by the hot wax and heat and to cause it to better stand the strain placed upon it. In assembling, the stack is preheated and the clamp tightened while the stack is under pressure. The clamping bars 27 are well outside the voltage gradient line and as the fiber is a fine non-conductor the two ends of the stack are carefully insulated from each other and the stack clamped. It is to be understood, however, that the present invention can be used with any suitable form of clamp, altho I have not abandoned the invention embodied in the clamp herein illustrated and described.

By connecting the sheets as above described a much neater stack is provided and the soldering is better. The construction provides an accordion like arrangement wherein the sections may be easily separated and the bad sections taken out and repaired without harming the other parts of the stack. Furthermore, the metal conducting sheets 16 between the sections are of substantial width, thereby acting as a shield or guard between sections protecting perfect sections against damage due to imperfect or injured sections adjacent thereto.

The connection 16 also provides means for conducting heat from the center of the stack to the exterior thereof. The ends of the connecting sheet 16 extend a substantial distance into wax X and are imbedded therein to conduct heat from the interior of the stack to the outside, the adjacent ends being maintained in separated relation to each other.

Another advantage of the zigzag or accordion construction for connecting the sections together lies in the fact that the soldering of the sections together can be done in one half the time formerly required since when forming the stack it will be necessary to solder on one side only. The method of constructing the present stack is as follows: One end of each connecting sheet 16 is bent over or around the foil bunch at one end of a section and soldered thereto, the heat being applied to the outside of the sheet to prevent damage to the foil bunch. The sections are next stacked with the connecting strips 16 interposed between them and with their free ends all lying at one side. The sections and connecting sheets 16 are properly supported in a clamp and the free ends of the connecting strips are bent over or around the bunches at the opposite ends of the sections and soldered thereto as above described. In this construction there will be no bending of the foil ends or bunches which are often damaged by such bending because such movement is very apt to break off the foil especially when covered or stiffened with hard wax, the flexible connectors 16 maintaining and supporting the bunches in position. By providing such strips or connectors which extend around the foil bunches and to one side, a substantial surface is provided for applying a hot iron without danger of breaking off the foil as now often happens in assembling the sections. In assembling the sections in the zigzag or accordion method, the end connectors 4 and 5 leading from the end sections to the terminals will always come off at the proper place, to wit, opposite ends of the sections, regardless of the number of sections. I provide a simple and symmetrical stack which may be easily and quickly assembled with danger of faulty connection at a minimum.

In the present construction, one section can be removed without spoiling the others, as the strips or connectors 16 are flexible and take up all mechanical strains and can be removed by merely heating the surface of the sheets with a hot iron. The stack furthermore can easily be inspected because the sections can be separated like an accordion.

By bending the ends of the connecting sheets 16 in opposite directions around

opposite ends or bunches of adjacent sections and soldering said free ends to the remote or outer portions of the foil bunches with the inner portions of the bunches and adjacent portions of the connecting sheet unattached, permits the ends of the foil bunches to be soldered without bending the foil bunches toward one another, which bending has resulted in the past in a considerable tension strain on the foil sheets on the side of the direction of bending and a compression or crumpling strain on the other side of the foil sheets, which has resulted in tearing the foil from the sections as mentioned above, all of which resulted in sparking and consequent destruction of the stack when put into use.

By means of the present invention, the foil bunches of each section are permitted to stand straight out when electrically assembled so that the foil bunches are under no excessive strains. The bent or doubled portions of the outer ends 18 and 20 of the sheets 16 permit each such portion to bridge over one end of an insulating sheet 1 so that all insulating sheets can be substantially of the same length and project equal distances beyond the ends of the sections but not beyond the connectors.

The present construction has an important electrical advantage over prior condensers wherein the sections are connected in series by means of a different arrangement consisting of connecting the terminals or ends of the sections alternately in pairs. It would increase the cost of production in this arrangement to exercise such care so to insure that the sections be properly connected in the stack, but also said prior arrangement resulted in providing a potential difference across the unconnected adjacent ends of adjacent sections and adjacent connectors (and consequent strain on the insulating sheets between the sections) which was twice that between the two ends of a section. The result was either a tendency to break down the insulation or at least cause brush discharges from the opposing sheets. These defects are avoided in my arrangement wherein the potential difference between an end of a condenser section S and an adjacent end of the adjacent section can never exceed the potential difference between the ends of a single section and wherein there is no harmful action due to potential differences between opposing faces of adjacent sections. The reason for this is found in the fact that each connecting sheet 16 lies adjacent the face of the section to one end of which it is connected so that there can be no greater potential difference between the sections and sheet 16 at any point than the total potential difference between the two ends of such section, and the same applies to the relation between sheet 16 and the section on the other side of it. Therefore conducting sheet 16 acts as an electrical barrier between the oposing faces of adjacent sections in the sense that even if there be considerable difference of potential between opposing faces of adjacent sections, yet sheet 16 acts to divide such potential difference because it is kept at an intermediate potential by reason of the fact that its ends are connected to opposite or remote terminals of the same sections which its body separates. These terminals must therefore be at the same potential and the difference of potential between any such terminal and an adjacent terminal of an adjacent section can be no greater than the difference of potential between the ends of either adjacent section. From this it will be apparent that the insulating sheets 1 have the function of insulating conducting sheet 16 from adjacent sections altho they will not have to withstand a greater difference of potential than that between the ends of a given section.

The arrangement of Figs. 3 and 4 has further advantages which are useful in manufacturing. Thus, in making the stack all the sections are connected together mechanically in the zigzag arrangement (before and if insulating sheets 1 are inserted) by the successive connecting sheets 16 the ends of which are soldered to the foil bunches. The sheets 16 being of thin metal as copper, are flexible, so that when soldered to the foil bunches, the stack altho now a unitary zigzag mechanical structure can nevertheless be expanded like an accordion and this is of great advantage in permitting ready inspection of the sections at the desired steps in the treatment, testing, etc. The metal of connecting sheets 16 takes up the strains accompanying said accordion action so that there is no undue strain on the soldered joints, altho of course it is desirable to have a joint of considerable area between connectors 16 and the foil bunches.

I claim:—

1. A high potential condenser consisting of a stack of sections adapted to be connected together in series, and a metal sheet between adjacent sections connected at one end to a given end of one of said adjacent sections and connected at its other end to the opposite end of the other of said adjacent sections whereby said sections are electrically connected in series.

2. A high potential condenser consisting of a stack of condenser sections, from which project bunches of the conducting sheets for connection together in series; two sheets of insulating material between each pair of adjacent sections, and a metal sheet located between said insulating sheets and formed with inwardly directed ends which extend from their integral metal sheet in

opposite directions from each other and are electrically connected with the adjacent bunches of conducting sheets.

3. A high potential series condenser consisting of a stack of sections from which project bunches of the conducting sheets for connection of the sections together; and a metal sheet located between adjacent sections and being electrically connected at one end to the foil bunch projecting from a given end of one of said adjacent sections and electrically connected at its other end to the foil bunch projecting from the opposite end of the other of said adjacent sections.

4. A high potential condenser consisting of a stack of sections from which project bunches of conducting sheets for connection of the sections together in series and a metal sheet between adjacent sections having one end extending around and connected to the outer portion of the bunch at a given end of one of said adjacent sections and having its other end extending around and connected to the outer portion of the bunch at the opposite end of the other of said adjacent sections.

5. A high potential condenser consisting of a stack of sections adapted to be connected together in series, and a flexible sheet between adjacent sections connected at one end to a given end of one of said adjacent sections and connected at its other end to the opposite end of the other of said adjacent sections, to allow an accordion like separation of said sections.

6. A high potential condenser consisting of a stack of sections adapted to be connected together in series, a metal sheet between adjacent sections connected at one end to a given end of one of said adjacent sections and connected at its other end to the opposite end of the other of said adjacent sections and electrically connecting said section in series, and sheets of insulating material between said adjacent sections and upon opposite sides of said connecting sheet.

7. A high potential condenser consisting of a stack of sections adapted to be connected together in series, a metal sheet between adjacent sections connected at one end to a given end of one of said adjacent sections and connected at its other end to the opposite end of the other of said adjacent sections, and sheets of insulating material interposed between said adjacent sections upon opposite sides of said connecting sheet, said insulating sheets being symmetrically arranged in the stack and projecting substantially equal distances from opposite sides thereof to points inwardly of the ends of said connecting sheet.

8. A high potential condenser consisting of a stack of sections from which project bunches of conducting material for connection of the sections together in series, and a metal sheet between adjacent sections having ends extending in opposite directions around and secured to the outer portions of bunches at opposite ends of said adjacent sections and being unattached to the inner portions of said bunches whereby the several sections are flexibly connected together and can be conveniently separated for inspection.

9. A high potential condenser consisting of a stack of sections adapted to be connected together in series, and a metal sheet between adjacent sections electrically and mechanically connected at one end to a given end of one of said adjacent sections and electrically and mechanically connected at its other end to the opposite end of the other of said adjacent sections, insulating sheets between said adjacent sections and upon opposite sides of said connecting sheet and means for clamping the several sections and sheets together.

10. A high potential condenser consisting of a stack of sections connected in series, dividing the total potential of the condenser among them and comprising a sheet of conductive material interposed between adjacent sections for conducting heat from the interior of the stack and to serve as a protective guard between the sections.

11. A high potential condenser consisting of a stack of sections connected in series, dividing the total potential of the condenser among them and comprising a sheet of conductive material interposed between adjacent sections for conducting heat from the interior of the stack and to serve as a protective guard between the sections and sheets of insulating material interposed between each side of said conductive sheet and an adjacent section.

12. A condenser consisting of a stack of sections adapted to be connected together electrically, and a metal sheet interposed between adjacent sections, extending beyond the bodies of said sections and connected thereto whereby said sheet performs the dual function of electrically and mechanically connecting said sections and providing heat conducting means to conduct heat from the interior of the condenser to the outside thereof.

13. A high potential condenser consisting of a protecting casing, a stack of sections therein adapted to be connected together in series, a metal sheet between adjacent sections electrically and mechanically connected at one end to a given end of one of said adjacent sections and electrically and mechanically connected at its other end to the opposite end of the other of said adjacent sections and projecting at its opposite ends beyond the bodies of said sections, insu-

lating means interposed between said sections upon opposite sides of said connecting sheet and a wax like substance in said casing in which said several sections and connecting sheet with projecting ends are imbedded.

14. A condenser consisting of a stack of sections adapted to be connected together electrically, a metal sheet interposed between adjacent sections, connecting the same together electrically and mechanically and serving as a guard between said sections, and insulating material interposed between any said section and said metal sheet.

15. A high potential condenser consisting of a stack of sections arranged in series, dividing the total potential of the condenser among them and from which project bunches of conducting sheets, a flexible metal sheet having relatively greater tensile strength than the material of which said bunches are composed, interposed between adjacent sections, having one end bent around a bunch at one end of said adjacent section and secured to the outer portion thereof, and having its opposite end bent around the bunch at the opposite end of the other of said adjacent sections and secured to the outer portions thereof, and being unattached to said bunches on their inner portions, insulating sheets interposed between adjacent sections upon opposite sides of said connecting sheet and arranged symmetrically in the stack and clamping means for said stack.

16. In a condenser, a stack comprising a plurality of sections having foil terminals, and means for electrically connecting said sections, comprising a sheet of metal interposed between the sections and projecting beyond the same, and to the projecting portion of which and by which the foil terminals are connected and supported respectively.

17. In a condenser, a stack of sections of alternate sheets of dielectric and relatively fragile foil, and means electrically connecting the sections together, including heat-conducting sheets of metal of relatively greater tensile strength than said foil and interposed between sections and extending beyond the same.

18. In a condenser, a stack of sections comprising alternate sheets of relatively fragile foil and dielectric, electrically connected and comprising sheets of conductive material having relatively greater tensile strength than said foil, and interposed between sections for conducting heat from the interior of the stack and to serve as a guard between sections.

19. In a condenser, a stack comprising a plurality of sections, means electrically connecting said sections comprising a metal sheet interposed between sections, and sheets of insulation interposed between each side of said metal sheet and an adjacent section.

20. In a condenser, a stack of sections composed of alternate sheets of dielectric and relatively fragile foil and electrically connected, a metal sheet of relatively greater tensile strength than said foil interposed between said sections, and clamping means for the stack.

21. In a condenser, a stack of sections composed of alternate sheets of dielectric and relatively fragile foil having foil terminals and electrically connected together, and a metal sheet of relatively greater tensile strength than said foil interposed between and projecting beyond said sections and supporting said foil terminals.

22. In a condenser, a stack of sections made up of alternate sheets of dielectric and relatively fragile foil having foil terminals, means electrically connecting said sections comprising heat-conducting sheets of metal of relatively greater tensile strength than said foil, interposed between and extending beyond the sections, and to the extending portions of which and by which the foil terminals are electrically connected and supported respectively, a clamp for said stack, and a metal casing for said clamp and stack, and constituting one terminal of the condenser.

BYRON MACPHERSON.