Feb. 8, 1938. B. G. OLVING 2,107,423

ELECTRIC CONDENSER CONSTRUCTION

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Fig. 2.

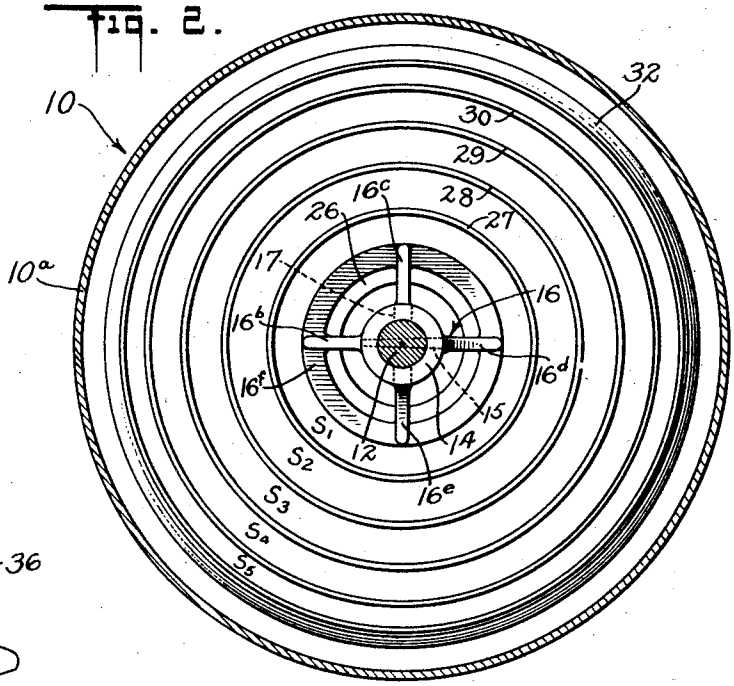


Fig. 1.

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Fig. 3.

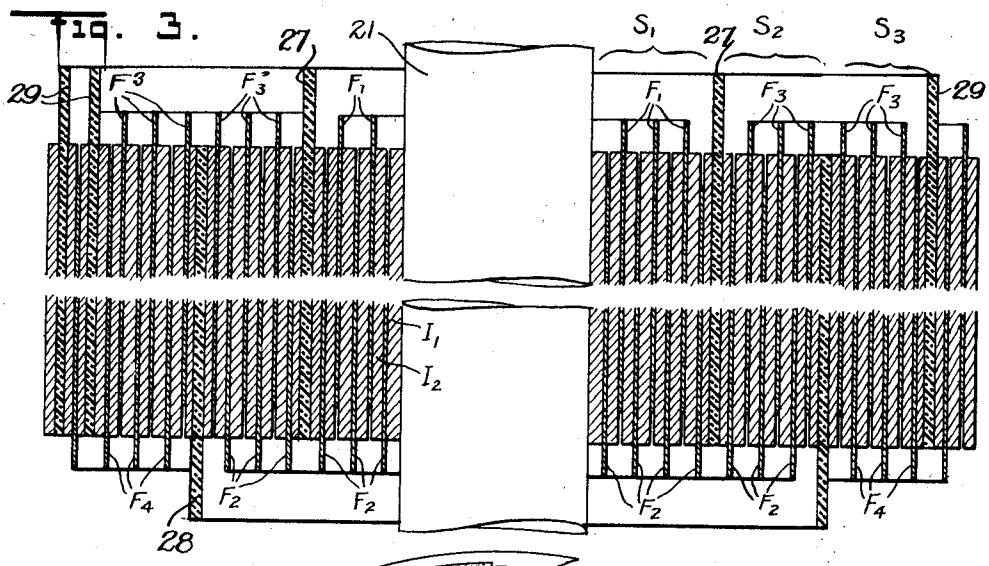
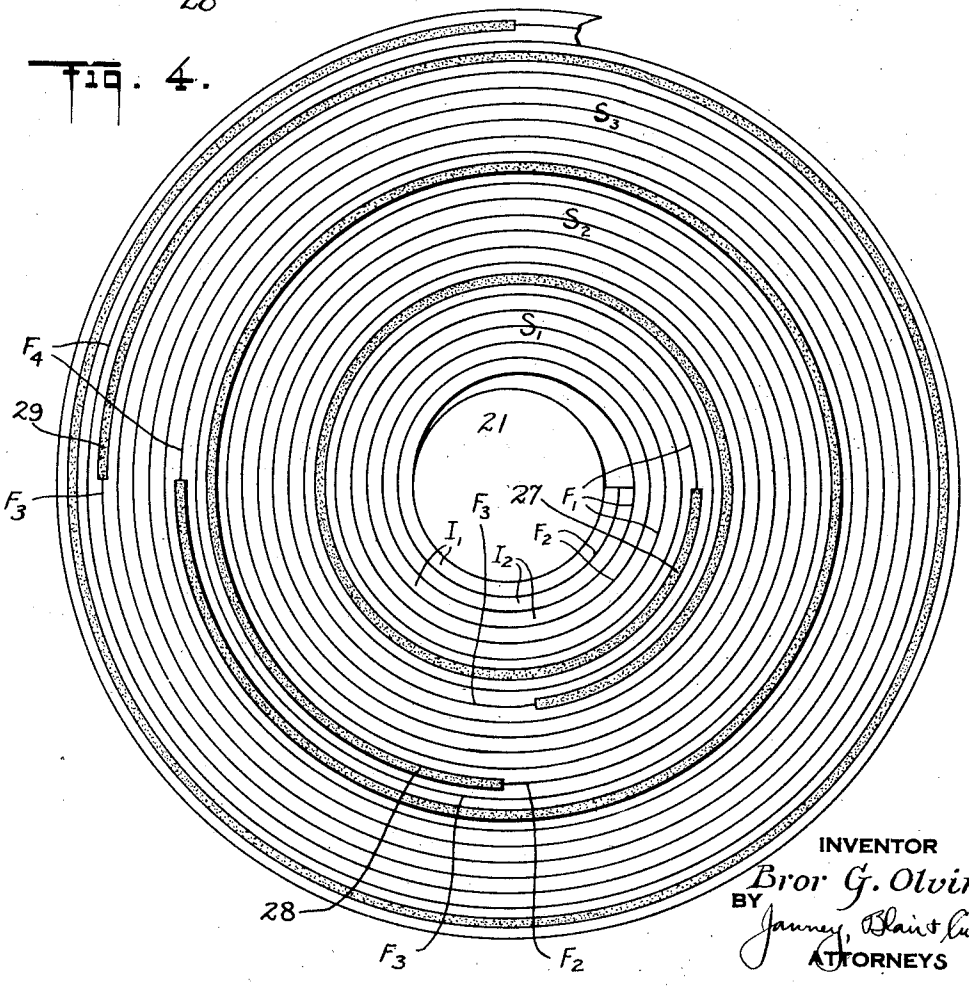


Fig. 4.



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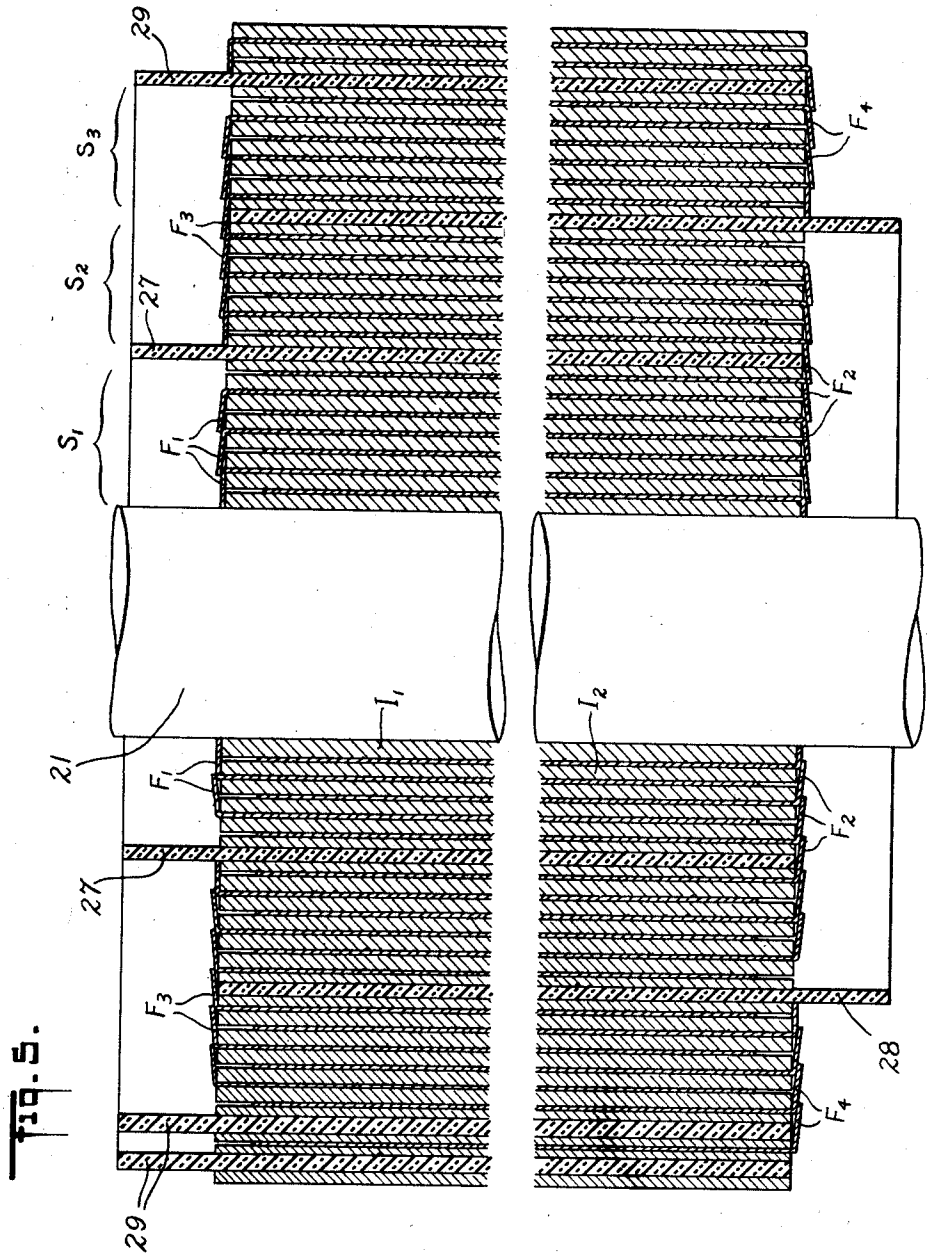


Fig. 5.

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Patented Feb. 8, 1938 2,107,423

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2,107,423

ELECTRIC CONDENSER CONSTRUCTION

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Application March 9, 1933, Serial No. 660,082

3 Claims. (Cl. 175—41)

This invention relates to electric condenser construction and more particularly to condenser construction adapted for high voltage application.

One of the objects of this invention is to provide a simple, inexpensive, and practical condenser construction that will be well adapted to meet the varying conditions of practical use, that will be capable of rapid manufacture and assembly and that will be rugged and reliable in use and action. Another object is to provide an electric condenser construction in which the electrical interconnecting of individual condenser sections may be quickly and inexpensively and reliably achieved. Another object is to provide a construction of the above-mentioned character in which thoroughly dependable insulation between condenser sections may be reliably and inexpensively achieved. Another object is to provide a simple, practical, and inexpensive electrical condenser having good electrical properties and capable of operation at high voltages. Other objects will be in part obvious or in part pointed out hereinafter.

The invention accordingly consists in the features of construction, combinations of elements, and arrangements of parts as will be exemplified in the structure to be hereinafter described and the scope of the application of which will be indicated in the following claims.

In the accompanying drawings, in which are shown several of the various possible embodiments of the electrical features of my invention,

Figure 1 is a vertical central sectional view through a completely assembled condenser;

Figure 2 is a horizontal sectional view as seen along the line 2—2 of Figure 1;

Figure 3 is a fragmentary sectional view through several condenser sections, on an enlarged scale, showing certain of the electrical portions of the condenser in one stage of their construction;

Figure 4 is an elevation as seen from the top in in Figure 3; and

Figure 5 is a view like that of Figure 3 showing another possible form which the condenser construction may take.

Similar reference characters refer to similar parts throughout the several views in the drawings.

Referring first to Figures 1 and 2, I have shown a casing 10 of any suitable construction adapted to enclose and house the condenser construction, together with a suitable insulating medium. By way of illustration the casing 10 may consist of a cylindrical pressed steel casing or tank in which the side walls 10^a and the bottom 10^b are preferably formed integrally with one another, the closure 10^c being applied as described hereinafter. Inasmuch as I have elected to illustrate the electrical features of my invention in coaction with a dielectric medium that is in the form of a gas, such as nitrogen, for example, under a pressure on the order of 15 atmospheres, I prefer to employ the casing construction just mentioned inasmuch as that casing construction is well adapted to withstand such heavy internal pressures.

The central portion of the closure 10^c is provided with a threaded opening 11 to receive a supporting rod 12 preferably of steel, the parts being so related that when the closure 10^c is in closing position, the rod 12 is substantially coaxial with the axis of the casing 10. Preferably the rod 12 is welded to the closure 10^c as at 13 in order to insure air-tightness.

Adjacent its upper end, as viewed in Figure 1, the supporting rod 12 carries a collar 14 pinned thereto as by the tapered pin 15 and abutting against the left-hand face of the collar 14 is a spider-like support generally indicated at 16, made of any suitable metal.

The member 16 is provided with a collar portion 16^a (see also Figure 2) adapted to abut against the metal collar 14, these parts being suitably shaped as is indicated at 17 to prevent rotation of the spider member 16 relative to the collar 14 and hence relative to the casing itself.

The spider member 16 has a number of radially extending arms, illustratively four in number and shown in Figure 2 at 16^b, 16^c, 16^d, and 16^e, these arms terminating at their lower outer ends (Figure 1) in a ring-shaped member 16^f.

At its lower end, as seen in Figure 1, the supporting rod 12 carries a somewhat similar spider member generally indicated at 18, the latter being provided with a ring-shaped member 18^f facing toward the ring-shaped member 16^f.

These two ring-shaped parts 18^f and 16^f are adapted to support my condenser construction, the latter being virtually clamped between the two spiders 16 and 18, a nut 19 (Figure 1) threaded onto the rod 12 and suitably locked as by a cotter pin 20, acting, with the rod 12, to draw the two spider members 16 and 18 toward each other and thus securely to hold the condenser construction in place.

The condenser construction is made up preferably of metal foil alternated with a suitable sheet dielectric such as an appropriate paper which

may be provided in one or more layers, alternated foils and paper being spirally wound.

Turning now to Figures 3 and 4, the winding of the sections of the condenser may now be considered. I first provide a suitable core **21**, preferably cylindrical and having a diameter equivalent to the minimum inside diameter which the spirally wound condenser is to have. In Figures 3 and 4 the core **21** is diagrammatically indicated but in practice I prefer to use as a core the part or parts which is or are to take part in the ultimate assembly of the condenser. By way of illustration, these parts may be built somewhat as shown in Figure 1.

Thus, I provide a supporting core made up of two hollow cylinders **22** and **23** of solid dielectric material, each approximating an axial length of about one-half of the axial length of the spirally wound condenser. These solid dielectric cylinders **22—23** are fitted into suitable bezels **24a** and **24b** of a ring-shaped support **24** whose outer periphery forms a continuation of the outer cylindrical surface of the thus alined cylindrical supports **22—23**. The ring members **24**, of solid dielectric material, such as bakelite, may be provided with a suitable number of inwardly directed or radially extending spokes **24c** whose inner ends terminate in a circle whose diameter is equal to the diameter of the supporting rod **12**. Members **22—23** may also be made of metal, and preferably are, thus aiding in the dissipation of possible heat losses.

Into the ends of the cylinder thus formed by the parts **22—23—24** are inserted collars **25** and **26** made of solid dielectric, such as bakelite, these rings being right-angled in cross-section so that the axially extending flange fits into the cylinders while the radially extending flanges thereof abut against the respective ends of the cylindrical members **22—23**.

These parts, thus assembled and held together in any suitable way, may be used as a core, diagrammatically indicated at **21** in Figures 3 and 4, on which the foil and paper insulation may now be wound.

Turning now to Figures 3 and 4, in which these parts are shown in exaggerated cross-section, I rotate the core **21** in any suitable way and start winding thereon two strips of metal foil F_1 and F_2 and two strips I_1 and I_2 of insulation, each, by way of example comprising one or more layers of suitable paper, these four strips being alternated, the insulation strips I_1 and I_2 having their edges alined while one foil strip F_1 is staggered upwardly with respect to the insulation strips and projects upwardly thereof and the other foil strip F_2 is staggered downwardly with respect to the alined insulation strips I_1 and I_2 and projects downwardly.

The inner edges of the foil strips, as is clearly shown in Figure 3, are remote from the alined edges of the strips of insulation and if the pressure of winding is adequate, and I prefer to make it so, the adjacent portions of the insulation strips that project beyond the inner edges of the foil strips are pressed into contact with each other and thus the inner edges of the foil strips are more effectively insulated.

The winding proceeds until an appropriate number of turns has been wound to result in a condenser section of the desired electrical capacity and characteristics; then the winding ceases and one of the two foil strips, foil strip F_1 (see Figure 4) is cut off and in its place, for a circumferential distance of well over one turn, I then insert a barrier generally indicated in Figures 3 and 4 at **27**. There has thus been thus far formed one condenser section which for convenience I designate in Figures 3 and 4 as S_1. In Figure 4 the barrier **27** will be seen to extend throughout one and a quarter turns, the two end portions overlapping each other by an arc of 90° and having extending therebetween the two insulation strips I_1 and I_2 with the foil F_2 between the latter.

This barrier **27** is made of any suitable solid dielectric material and, for example, may comprise several thicknesses of a suitable paper, for example, five thicknesses of fish paper, the latter being 0.010'' thick. These illustrative figures are appropriate where the barrier is to function with respect to a voltage of 2300.

The width of the barrier **27** (its length in an axial direction as seen in Figure 3) is such that, when its one edge is alined with the lower alined edges of the insulation strips I_1 and I_2, the other or upper edge as viewed in Figure 3 projects from the upper face of the coil a distance sufficient to provide a barrier for the potential difference that exists between the projecting foil strips on either side of the projecting part of the barrier.

The winding is now resumed, but with what was formerly foil F_1 from the foil supply becoming foil F_3 in Figure 4 abutted against the outermost edge or end of the barrier **27**. The winding now continues, winding the two insulation strips I_1 and I_2 and the foil strip F_2 and foil strip F_3, all alternated with each other. The interruption in the winding of the one foil caused by cutting off the foil, as earlier above noted, will be seen, by reference to Figure 4, to be made up by the barrier **27** whose respective ends abut the outer terminus of foil F_1 and the inner terminus of foil F_3. The continued winding is carried on to provide the next section S_2 of the condenser, the two sections S_1 and S_2 being electrically connected in series in that the foil F_2 will be seen to extend continuously from one section on through and into the other, while the two sections are adequately insulated from each other by the high voltage barrier **27**.

The winding continues, as above noted, but is interrupted after sufficient turns have been wound to give the section S_2 an electrical capacity equivalent to that of the smaller-diametered section S_1, section S_2, having larger inside and outside diameters, requiring fewer turns than section S_1. Thereupon foil F_2 is cut and and the winding is continued for well over one turn, illustratively one and a quarter turns, but with a barrier **28**, similar to the barrier **27**, substituted for the foil F_2 during this one and a quarter turn of this winding. But barrier **28** is alined (see Figure 3) with the upper edge of the condenser sections and projects beyond the lower edge.

The winding of both foil strips interleaved with the insulating strips is now resumed and, where the inner end of the barrier **28** abuts against the end of the foil strip F_2, its outer end (Figure 4) has abutted against it the end of foil strip F_4, and the foil strips F_3 and F_4 interleaved with the insulating strips I_1 and I_2 are now wound to form an additional section S_3, sufficient turns being made to give the section S_3 the desired electrical capacity. Sections S_2 and S_3 will be seen to be serially connected in that the foil strip F_3 extends throughout both, a portion of it forming virtually the interconnecting element. Sections S_2 and S_3 are insulated by the barrier **28** together

with immediately adjacent insulation strips I_1 and I_2. These steps are repeated to form as many condenser sections with desired capacities, preferably equal, as may be desired, the process resulting in alternate foil plates extending continuously throughout two successive sections, thus connecting such sections in series.

In Figure 1 I have shown the condenser thus wound as being made up of five sections, all serially connected as above described; these sections are sections S_1, S_2, S_3, S_4, and S_5 with interposed barriers **27**, **28**, **29**, and **30**.

The projecting portions of these barriers **27**, **28**, **29**, and **30** alternate, and are better shown in Figure 3; thus, the upwardly projecting portion of the barrier **27** forms a barrier for the potential difference that exists between the projecting foil strips F_1 and F_3 and since the foil strip F_2 is continuous or common throughout the sections S_1 and S_2, it is of the same potential throughout and the downwardly projecting edge portions of the foil strip F_2 that are respectively allocated to the sections S_1 and S_2 need not, therefore, be separated by a projecting barrier and for that reason the lower edge of the barrier **27** can be alined with the lower edge of the insulating strips I_1 and I_2. In like manner, the downwardly projecting portion of barrier **28** insures a sufficiently long leakage path between the downwardly exposed foil members F_2 and F_4 (between which a potential difference does exist) while its upper edge can be alined with the upper edge of the insulating strips I_1 and I_2 inasmuch as the upwardly exposed foil members F_3 to either side of the plane of the barrier **28** are of the same potential. In like manner the remaining barriers alternately project from the convolutions of the condenser roll.

The outermost section S_5 is then covered with an appropriate number of turns of solid dielectric material, such as fish paper; the resultant insulation is indicated at **31**. Then I apply a few turns of tightly wrapped laminated metal, such as sheet copper, brass or aluminum, preferably of a width considerably in excess of the axial dimension of the condenser sections, thus forming virtually a metal sleeve **32** which serves to hold the complete assembly rigid and intact and providing thereby also a good heat-radiating surface.

The resultant condenser unit, thus made up of these superimposed serially connected sections, one wound upon the other, and all wound about the core assembly as above described, is now slipped onto the rod **12** (Figure 1) with the insulating collar or ring **26** interfitted with the flanged or bezeled ring **16^f** of the spider member **16**; the parts may be held against relative rotation as by a dowel pin **33** set into suitable mating recesses in the parts **26** and **16^f**.

Then the spider member **18** is slipped onto the supporting rod **12**, its ring member **18^f** similarly interfitted with the insulating collar **25**, the nut **19** tightened up sufficiently to securely hold the parts together and the nut **19** locked.

Of the inside section S_1 foil F_1 is suitably connected to a conductor or lead **34** (Figure 1) while a lead or conductor **35** is connected to the foil plate member of the outermost section S_5 that is individual to that section. These leads **34—35** may be then related to any suitable terminal bushings, or the like, and by way of illustration I have shown the conductor **34** grounded to the spider member **16** and hence to the casing, and I have shown the lead **35** connected to the conducting element of an insulating bushing **36** which is preferably mounted upon or related to the closure member **10^c**.

The closure member **10^c**, thus carrying the terminal bushing and the condenser, is now related to the casing **10**, the lower end of the rod **12** being received in an opening **37** in the bottom **10^b** so that the rod **12** finds itself supported at its ends by the bottom and closing walls **10^b** and **10^c** of the container. The lower end of the rod **12** is preferably welded about the periphery of the opening **37** and to the bottom **10^b**, as is indicated at **38**, thus to make a dependable air-tight joint. The closure member **10^c** may now be secured in place. The closure **10^c** is preferably dimensioned to be received within the open end of the cylindrical side walls **10^a** of the container, whereupon the upper edge portions of the latter are hammered or bent over as at **10^d** (Figure 1) and then welded as at **39** to make an hermetic seal or joint.

The insulating and cooling medium may thereupon be placed in the container and where that takes the form of a gas under pressure, it may be injected through a nipple **40** threaded into the upper end of the supporting rod **12**, the parts being provided with suitable channels or passages opening into the interior of the sealed casing; the parts may also be so constructed that the nipple **40** supports a gage **41** to indicate the pressure of the gas within the container.

The gas under pressure coacts with the projecting ends of the barriers **27**, **28**, **29**, and **30** and so vastly increases their resistance to surface leakage that the projecting portions of the barrier may be greatly diminished in their dimensions. The gas under this high pressure also permeates throughout the paper insulation employed and improves the dielectric strength thereof. The spoked arrangement of the parts **18**, **24**, and **16** (Figure 1) provides a central annular passage joined at its upper and lower ends with the outer annular passage between the metal shield **32** and the side walls **10^a** of the casing **10**, thus providing for the dependable and continuous circulation of the dielectric medium into contact with the condenser construction in order to abstract heat therefrom and with the walls of the casing through which the heat is thus dissipated; in this action the metallic shield **32** coacts in that, being a good conductor of heat, it readily abstracts the heat from the condenser and, providing as it does a large exposed surface, effects a rapid transfer of this heat to the insulating medium.

The metallic shield **32** functions also as an electrostatic shield between the outermost and hence high voltage sections S_5 of the condenser and the grounded casing **10**.

The construction will thus be seen to be simple, compact, and rugged, and capable of rapid construction and assembly. The many heretofore existing difficulties of interconnecting sections will be seen to be dependably and inexpensively eliminated in the unique provision of the steps and arrangement whereby one of the foil strips of two adjacent sections functions as a series connection between the latter.

Under some circumstances, it may be necessary to provide for the carrying of heavy currents through the condenser and in that case the projecting edges of foil strips of like polarity (see Figure 3) may be interconnected as by treatment with a metal spray gun or by soldering, the projecting edge portions being overlapped in

any suitable way. Illustratively one of these arrangements is shown in Figure 5 in which the projecting edge portions of the foil strips are laid down in overlapping relation to one another throughout the regions intervening the successive projecting portions of the barriers. Thus, the projecting edge portions of the foil strip F_1 are laid over one another and interconnected as by soldering or metal spray throughout the region intervening the core 21 and the projecting part of the barrier 27; likewise, the projecting portions of the foil strip F_2 that project in the region between the core 21 and the projecting portion of the barrier 28 are similarly treated, then the projecting portions of the foil strip F_3 that project in the region between the projecting portions of the barriers 27 and 29 are similarly treated, and so on. As already noted this arrangement of interconnecting the projecting edges of the foil strips of like polarity has the advantage of higher current-carrying capacity and it also has the advantage of achieving a non-inductive capacitance. The projecting portions of the barriers, moreover, greatly simplify the achievement of these interconnections since two successive projecting barriers define the region throughout which this interconnecting is to take place.

Thus, it will be seen that there has been provided in this invention a condenser construction and a method of achieving the same in which the various objects hereinbefore mentioned, together with many thoroughly practical advantages, are successfully achieved.

As many possible embodiments may be made of the mechanical features of the above invention and as many changes might be made in the embodiments above set forth, all without departing from the scope of the invention, it is to be understood that all matter hereinabove set forth or shown in the accompanying drawings is to be interpreted as illustrative and not in a limiting sense.

I claim:

1. In condenser construction, in combination, a casing having extending therethrough a substantially centrally positioned supporting member, means forming a hollow but externally cylindrical core supported by said supporting member with its inner walls spaced from the latter, thereby to form an annular passage therebetween, a condenser comprising a plurality of annular concentric condenser sections, the innermost of which is supported by said core, said sections being connected in series and the outermost section being of highest voltage, the outside diameter of said outermost section being less than the inside dimension of said casing, thereby to form a space therebetween, metallic means about said outermost section forming an electrostatic shield between it and the walls of said casing, and an insulating and cooling medium within said casing for circulation through said passage and through the space between the outermost section and the walls of said casing.

2. In condenser construction, in combination, a casing having extending therethrough a substantially centrally positioned supporting member, means forming a hollow but externally cylindrical core supported by said supporting member with its inner walls spaced from the latter, thereby to form an annular passage therebetween, a condenser comprising a plurality of annular concentric sections, each comprising two foil members and two insulating members alternated with each other and arranged spirally, the innermost section being supported by said core and said sections being successively superimposed upon one another, the outside diameter of the outermost section being less than the inside dimension of said casing, thereby to form an outer passage therebetween, and an insulating and cooling medium for circulation in said passages.

3. In condenser construction, in combination, a casing, a condenser supported within said casing, a shield member surrounding said condenser having a tube-like center portion and end portions, said shield being centrally located within said casing, said center portion of said shield being spaced a distance from said casing over its entire outer surface and said end portions of said shield being spaced from said casing said distance at the points where said end portions are adjacent to said center portion and being spaced progressively greater distances from said shield at points remote from said center portion, said condenser having one of its terminals attached to said casing.

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