March 15, 1932. W. H. PRIESS 1,849,885

CONDENSER AND PROCESS

Original Filed April 30, 1920

Fig. 3.

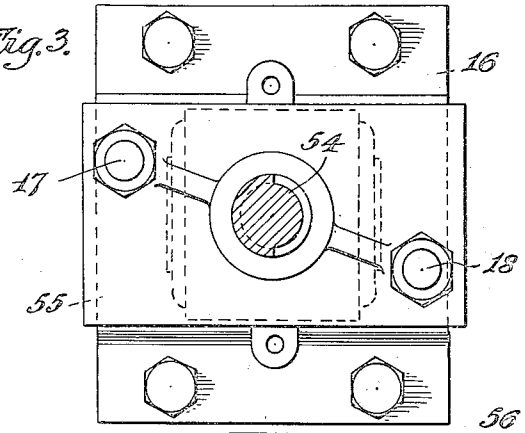


Fig. 5.

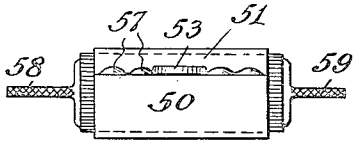


Fig. 4.

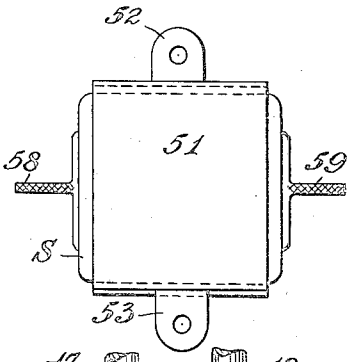


Fig. 1.

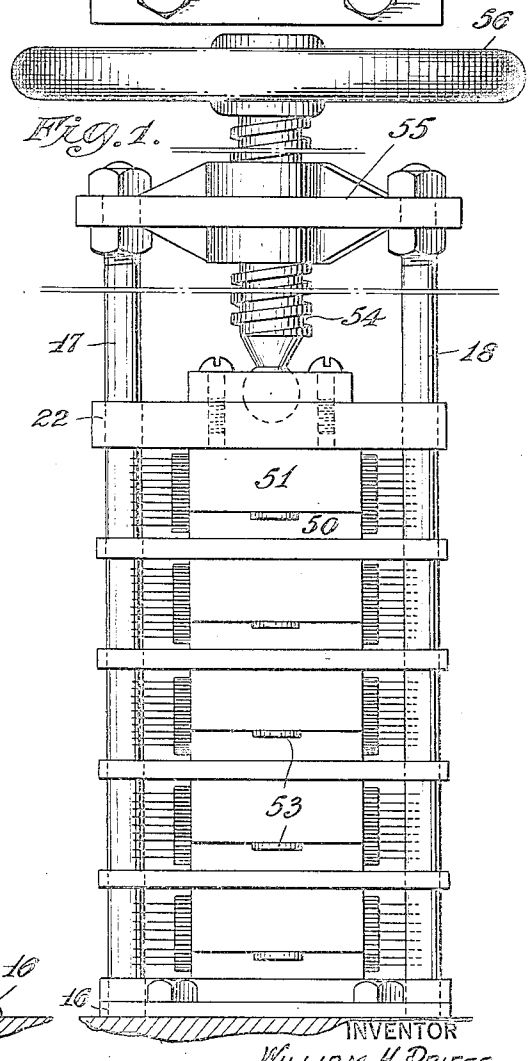
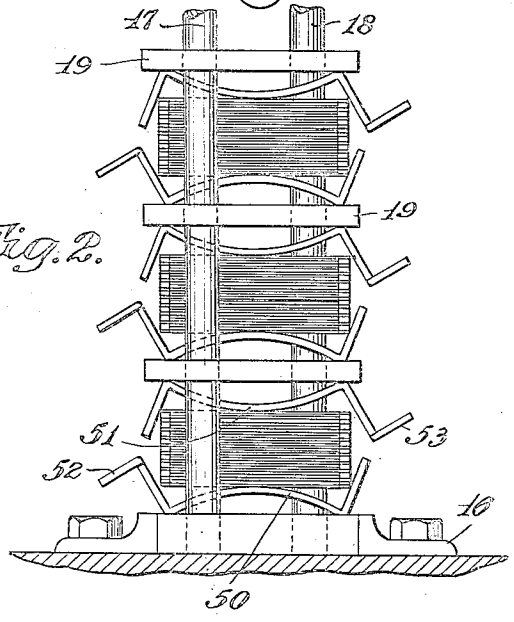


Fig. 2.



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UNITED STATES PATENT OFFICE

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CONDENSER AND PROCESS

Original application filed April 30, 1920, Serial No. 377,977. Divided and this application filed November 16, 1927. Serial No. 233,575.

One of the first steps in the process of making condensers consists in assembling alternate sheets of conducting and dielectric materials to build up a condenser stack of the required height, these sheets of material being separated by insulation having suitable properties for this peculiar class of work. Notwithstanding great care in selecting these materials and in assembling them, it is a very common experience to have a condenser break down during test or while in use and it has been definitely determined that a very important cause of such breakdowns is the presence of voids, gas, or an excessive amount of insulating material between the sheets of material that make up the condenser.

It is an important object of the present invention to devise a process of making condensers which will reduce to a minimum imperfections and faults of the character above mentioned. In other words, the invention aims to devise a process of building condensers which will eliminate an unnecessary thickness of insulating material between the layers of conducting and dielectric materials that make up the condenser and which will also reduce to a minimum the presence of voids, blisters or bubbles in the condenser. It is also an object of the invention to devise a process of making condensers which will produce a condenser that is a firm mechanical mass, that will have a very low dielectric loss and in which the leakage between successive conducting elements of the condenser will be reduced to a minimum. A further object of the invention is to improve condenser constructions both from an electrical and also from a mechanical standpoint.

This application is a division of my copending application Serial No. 377,977, filed April 30, 1920, which has eventuated into Patent No. 1,721,503, dated July 23, 1929.

The invention also consists in certain new and original features of construction and combinations of parts hereinafter set forth and claimed.

Although the novel features which are believed to be characteristic of this invention will be particularly pointed out in the claims appended hereto, the invention itself, as to its objects and advantages, the mode of its operation and the manner of its organization may be better understood by referring to the following description taken in connection with the accompanying drawings forming a part thereof, in which

Fig. 1 is a front elevation showing a step in the process of manufacturing of a condenser constructed in accordance with the invention and the apparatus used therefor;

Figs. 2 and 3 are side and plan views of the apparatus shown in Fig. 1; and

Figs. 4 and 5 are plan and side views respectively of the finished condenser.

Like reference characters denote like parts in the several figures of the drawings.

In the following description and in the claims parts will be identified by specific names for convenience, but they are intended to be as generic in their application to similar parts as the art will permit.

Assuming that the mica or other dielectric elements to be used in the condenser have been made by splitting the mica sheets to the desired thickness and cutting them out to the required shape and dimensions, and also that the tin foil or other conducting elements of suitable shape and size have been provided, the next step is to coat the mica elements with varnish or other adhesive insulating material. It is desirable that this coating shall be very thin and that it shall completely cover both surfaces of each mica sheet. This coating operation may be performed in any suitable manner and with any suitable insulating material, such for example as varnish.

After the dielectric elements have been coated and partially dried, they are next

assembled with sheets of tin foil, or other conducting material of the proper size and shape, to form a condenser stack. The condenser stack may either be built up in the form of a tall stack that later is split up into units of the required height, or the stack may be built up in the form of individual units, each unit stack being kept separate from the others.

After the assembly of the stack has been completed, the stack is next heated or baked for the purpose of driving out the solvent in the varnish, eliminating any excess of varnish between the elements, and driving out any gas or vapor that may be pocketed between the elements of the stack. A further result accomplished in the baking operation when certain varnishes are used is the oxidizing or chemical changing of the solid constituents of the varnish.

For this purpose the condenser stack preferably is transferred to a baking stand of the general character illustrated in Figs. 1, 2 and 3.

Assuming that the condenser stack has been assembled in units, as above described, these units are placed one above the other in a stand which comprises a base 16 and two posts 17 and 18 rising from the opposite sides of the base and threaded near their upper ends. The individual units are separated from each other by separator strips 19 of brass or other suitable material having holes drilled in them so that they slide freely on the posts 17 and 18.

Each unit is located between two metallic spring plates normally convexly curved or bowed with reference to the condenser, as clearly shown in Fig. 2, one of these plates being designated at 50 and the other at 51. It will be seen that the plates are alike in construction and that each plate is provided at opposite ends with projections extending at substantially right angles to the plate and designed to fit over the opposite sides or edges of the condenser unit. Ears 52 and 53 also project on these plates and have holes punched in them. The parts 50 and 51 consist preferably of a metal which can be easily bent or shaped to form the intermediate spring portions and the rigid angular projections. Any suitable sheet metal is adapted for this purpose, such as steel or phosphor bronze. In assembling the parts 50 and 51, the spring portions are arranged on opposite sides of the stack with their convex surfaces facing the same and in parallelism with the sheets composing the stack. They are then compressed flat against the stack and rigidly secured at opposite sides as hereinafter described to maintain the sheets together under spring compression.

The clamp comprises two parts which can be cheaply made and easily assembled to maintain the stack under good compression and at the same time allow the leads to be brought out at opposite ends of the stack, the stack projecting at opposite ends beyond the clamp.

The individual units with their respective pairs of plates are separated by plates 19, the entire stack of units being set up in the baking stand, as shown in Fig. 1. This baking stand also is provided with a pressure plate 22 mounted to slide on the rods 17 and 18 and arranged to bear on the top of the stack of units. Any suitable means may be provided to compress the stack, that shown consisting of a square threaded screw 54, having a ball ended connection with the pressure plate 22 at its lower end and threaded through a yoke or plate 55 which is removably secured to the upper ends of the rods 17 and 18. The handle 56 is secured to this screw and affords a convenient means for turning it. It will be seen that with this arrangement the entire stack can be compressed until the springs 50 and 51 are straightened out, thus compressing the units with a spring pressure. The baking stand with the stack of condenser units clamped therein is then placed in an oven and baked for several hours at a temperature of approximately 110° to 115° C.

While the greater part of the solvent in the varnish coating of the dielectric elements is eliminated before these elements are assembled to form a condenser stack, a certain amount of solvent still remains in the lower layers of the varnish coating. Furthermore, the coating is thicker than is necessary. The baking of the stack while it is maintained under a heavy spring pressure squeezes out the surplus varnish which softens under the relatively high degree of heat to which it is subjected. At the same time this comparatively high heat vaporizes the solvent together with any other vaporizable elements, such for instance as traces of water, which may be pocketed between the sheets, and the heat, together with the pressure, co-operate to reduce to a minimum gas, vapor, and the thickness of the adhesive remaining between the sheets. In other words, the heat tends to diffuse any gases or vaporizable materials present between the sheets while the pressure tends to squeeze out these materials from between the sheets of the stack. When separator plates 19 made of brass or similar material are used, as distinguished from insulating material, they serve not only to separate the units and give the stack additional mechanical rigidity, but also to conduct heat into the interior of the stack and thus to facilitate the baking operation. The oven is ventilated during the baking operation for the purpose of carrying off the solvent vapors and also, when an oxidizable varnish such as copal varnish is used, to provide an ample supply of oxygen to effect this oxidation.

I regard the use of a spring in the application of pressure as especially important. The very desirable results produced by this process apparently are due to a more thorough elimination of gas and vapor from between the elements of the condenser and to a reduction in the thickness of the varnish or other adhesive remaining between the condenser elements after the baking operation has been completed.

Another factor contributing to the superior results produced by this process is the above described elimination of the greater part of the solvent from the varnish coating on the dielectric elements before these elements are assembled to form a condenser stack. This leaves only enough solvent in the coating to cause the coating to soften and become sticky during the baking operation, which result is desirable at this time for the purpose of adhesively securing all the sheets of material firmly together, and since only a relatively small quantity of solvent still remains in the coating, the elimination of the solvent can be made much more complete by the baking step than would otherwise be practicable. A further advantageous result produced by this process is the sealing of the marginal spaces between adjacent dielectric elements of the stack. Each conducting element lying on a mica sheet is surrounded on three sides by an inactive margin of mica; that is, an area of mica that is not subjected to the dielectric strain. This margin is covered with varnish during the coating operation, as above described, and the compression to which the condenser stack is not subjected to the dielectric strain. This margin is covered with varnish during the coating operation, as above described, and the compression to which the condenser stack is subjected during the baking operation results in squeezing additional varnish out from between the overlapping sheet and into these marginal spaces.

This varnish completely seals the space between the inactive margins of adjacent dielectric elements. It will be understood that when a condenser is in use there is a tendency for the current to discharge from the edge of one of the conducting elements across the inactive margin to the edge of the next adjacent conducting element. Ordinarily, a comparatively free path is left for this discharge over the surface of the mica. The sealing of these marginal spaces, however, by varnish introduces a solid wall of insulating material in the path of this discharge and thus reduces very substantially the surface leakage that otherwise would be present in the condenser. In other words, this construction reduces the electrical loss in the condenser.

After the baking operation has been completed, the condenser will be found to be a firm, mechanical mass capable of withstanding very rough usage. The sealing of the edges, as above described, contributes to this result and also is of advantage when the condenser is to be used in a damp location.

After the condenser has been baked its manufacture may be completed in any desired manner. According to the process which I prefer at present, the condenser units are next tested and any units which fail to withstand the tests are discarded. In order to reduce still further the electrical losses in the condenser and also for the purpose of improving its mechanical structure, it is preferable under some conditions to repeat the baking operation.

This second baking need not be continued as long as the first but usually is from six to eight hours at a temperature from 110 degrees to 115 degrees C. The exact nature of the change produced in the condenser by this second baking is difficult to determine but probably is due to some change produced in the exceedingly thin film of varnish that still remains between the adjacent elements of the condenser. I have determined, however, by actual test that the electrical characteristics of the condenser are improved by this second baking and that they can be still further improved by a third or fourth baking. The degree of improvement, however, decreases with successive bakings and usually it is not advisable from a manufacturing standpoint to carry the condenser through more than two of these heat cycles.

The heating or baking, and if desired also, the reheating or subsequent baking operations are performed in the manner above described, but after the baking operation has been completed the projecting ends of the spring plates which have now been brought into overlapping relationship at opposite sides of each unit, are permanently secured together by soldering or welding. Preferably this securing operation is performed by spot welding, as indicated at 57, Fig. 5. The condenser terminals 58, 59 are shown in Figs. 4 and 5 connected to the foil sheets projecting from the stack. As shown in Fig. 4 the integral parts 52, 53 are formed with holes for securing the finished condenser in place.

This process results in enclosing the condenser stack in a casing which because of its resilient nature and the manner in which it is secured on the stack, exerts a permanent spring pressure on the stack over substantially its entire active areas. After the securing operation the units may be removed from the baking stand.

The connections to the opposite sets of conducting elements can be made in any convenient manner as, for instance, by soldering leads 58 and 59 to these conducting elements respectively, with a suitable soft solder. The punched ears 52 and 53 are provided to facilitate the securing of the completed condenser

to its support. This construction provides a very compact and efficient condenser especially adapted for locations where the condenser is subjected to rough usage.

While certain novel features of the invention have been shown and described and are pointed out in the annexed claims, it will be understood that various omissions, substitutions and changes in the forms and details of the device illustrated and in its operation may be made by those skilled in the art without departing from the spirit of the invention.

What is claimed is:

1. A sheet condenser which consists of a stack of interleaved flat sheets of mica and metal foils, the foils of opposite potential extending out from spaced-apart portions of the side of the stack; and a two-part metal clamp, the two parts of which extend flat over substantially the entire surfaces of the two faces of the stack; one of said clamp-parts tending to assume a convexly curved shape with reference to the stack-face which it engages; and said parts having portions extending over portions of the side of the stack other than those from which the foils extend, to overlap one another; and said overlapped portions being permanently secured together while said convex part lies substantially flat against the stack, whereby the stack is held under permanent spring compression.

2. The combination with an electrical condenser stack of mica and foil sheets, of two metal plates holding the stack between them in the direction of its height, and means for holding the stack under pressure between said plates; at least one of said plates being constructed to tend to assume a convexly curved shape and having its bowed portion arranged to bear against an end of the stack, said plate being substantially straightened under said pressure.

3. In an electrical condenser, a stack of condenser elements and a clamp for said stack comprising members engaging opposite sides of the stack, at least one of said members having integral lateral portions connected to the other member, at least one of said members having a springy portion parallel with said elements whereby the elements are held together under spring compression.

4. In an electrical condenser, a stack of condenser elements and U-shaped spring clamping members having intermediate portions engaging opposite sides of the stack and connected together, holding the members against the stack to compress the elements together under spring pressure.

5. In an electrical condenser, a stack comprising alternate sheets of conductor and dielectric and a multi-part open ended sheet metal clamp for the stack and comprising metal plates upon opposite sides of the stack and integral lateral overlapping portions securing the parts together in clamping relation against the stack.

6. In an electrical condenser, a flat faced stack comprising alternate flat sheets of conductor and dielectric and a multi-part metal clamp for the stack and comprising plates lying flat upon and extending over substantially the entire surface of the opposite flat faces of the stack and having integral portions extending at angle with the plates and along the sides of the stack and connecting the parts together in permanent clamping relation against the stack.

7. In an electrical condenser, a stack comprising alternate sheets of conductor and dielectric and a multi-part metal clamp for the stack and comprising spring plates engaging opposite sides of the stack and having integral rigid lateral portions overlapping each other and securing the parts together in clamping relation against the stack under spring pressure.

8. In an electrical condenser, a stack comprising alternate sheets of conductor and dielectric and a sheet metal clamp for the stack and comprising plates engaging opposite faces of the stack and angularly arranged integral lateral portions bent to connect the plates together in clamping relation against the stack, at least one of said plates being a spring and adapted to assume a concavo-convex shape when released.

9. In an electrical condenser, a stack comprising sheets of conductor and dielectric and metal spring plates upon opposite sides of the stack and connected together along opposite edges of the stack transversely of the sheets to hold the sheets in contact under spring pressure.

10. In an electrical condenser, a stack comprising sheets of conductor and dielectric and a clamp for said stack comprising spring members upon opposite sides of the stack and means connecting them and extending along opposite edges of the stack and transversely of the edges of the sheets for maintaining said members in clamping relation against the stack holding the sheets together under spring pressure.

11. In an electrical condenser, a stack comprising alternate sheets of conductor and dielectric and a sheet metal clamp for the stack comprising parts at opposite faces of the stack, at least one of which is springy, and integral rigid lateral portions bent to extend along opposite edges of the stack and connecting the parts together in clamping relation against the stack, holding the latter under spring pressure.

12. In an electrical condenser, a stack comprising alternate sheets of conductor and dielectric and sheet metal spring plates engaging opposite sides of said stack, at least one of said plates having integral lateral portions bent to extend along opposite edges of the

stack to connect the plates together, clamping the stack under spring pressure, said plates being formed to assume a concavo-convex shape when released with the convex sides facing the stack.

13. An electrical condenser comprising a stack of dielectric and armature material, a metal end member for said stack having portions adapted to extend along opposite sides of said stack, said end member having its side portions diverging from the stack and being pre-shaped to move said side portions inwardly toward the stack on the application of pressure to said end member.

In testimony whereof I hereunto affix my signature.

WILLIAM H. PRIESS.