Dec. 15, 1931. W. M. BAILEY 1,837,142

PROCESS OF EMBEDDING ELECTRICAL CONDENSERS

Filed April 28, 1926 3 Sheets-Sheet 1

Fig. 1.

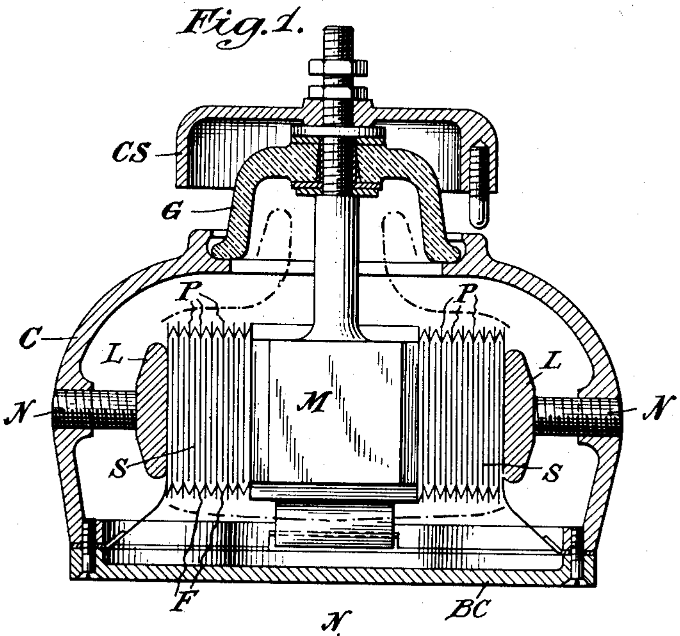


Fig. 2.

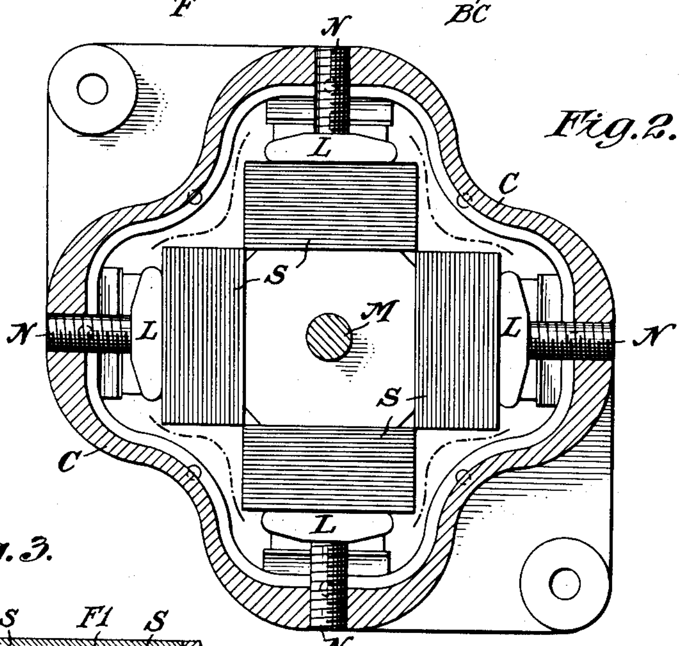
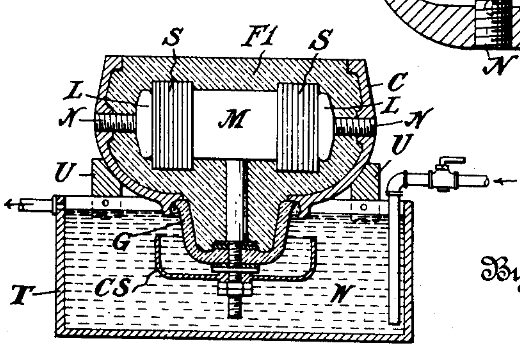


Fig. 3.



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PROCESS OF EMBEDDING ELECTRICAL CONDENSERS

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Fig. 4.

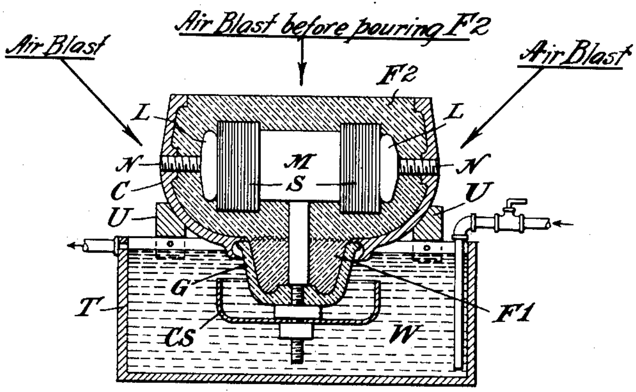


Fig. 5.

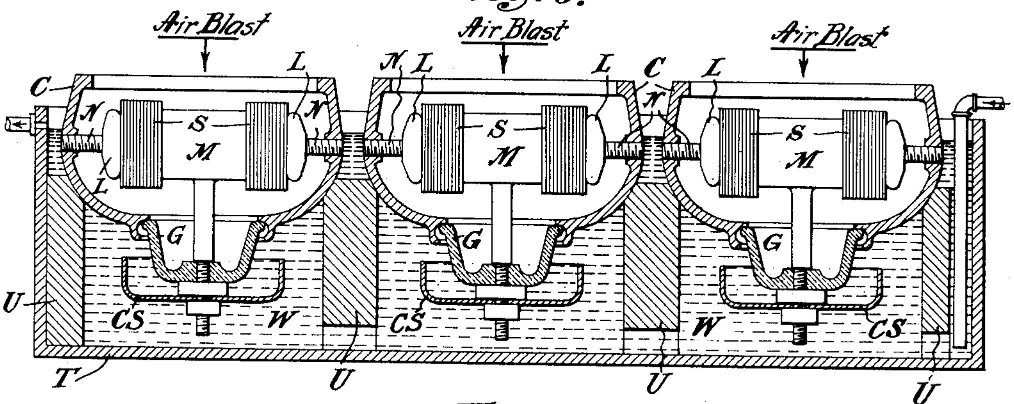
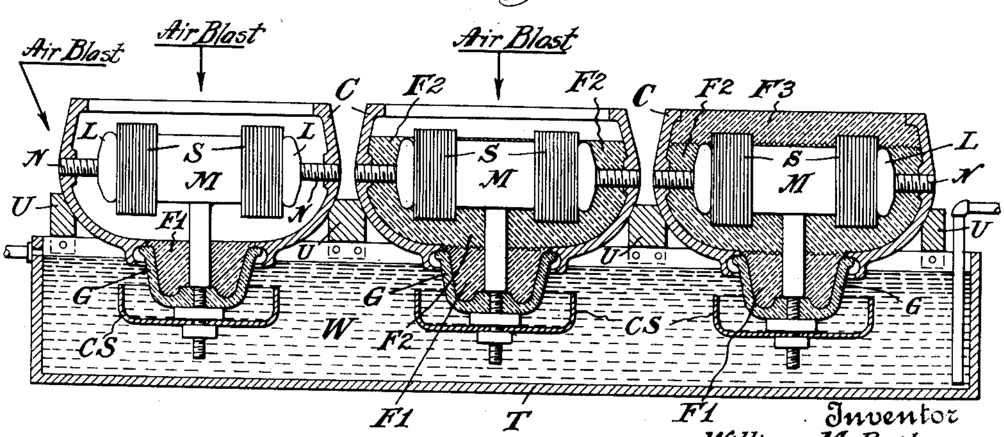


Fig. 6.



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PROCESS OF EMBEDDING ELECTRICAL CONDENSERS

Filed April 28, 1926 3 Sheets-Sheet 3

Fig. 7.

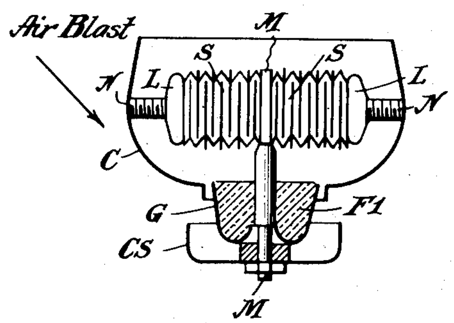


Fig. 8.

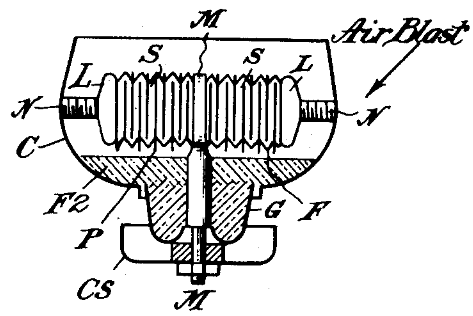


Fig. 9.

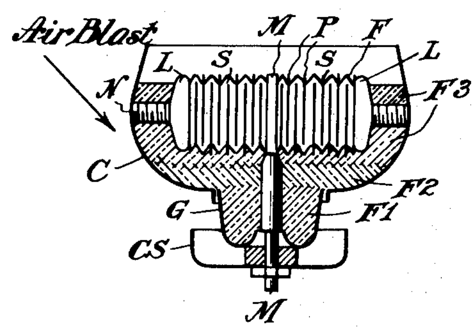


Fig. 10.

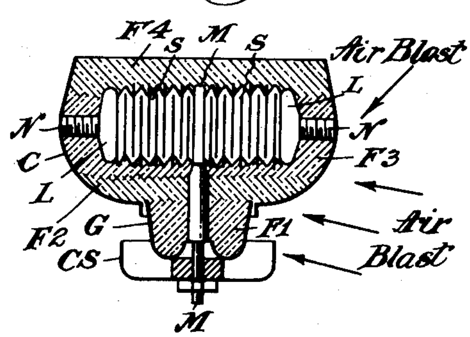
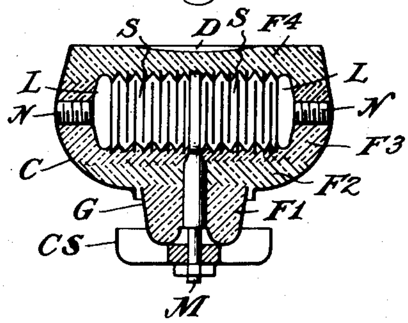


Fig. 11.



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Patented Dec. 15, 1931

1,837,142

UNITED STATES PATENT OFFICE

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PROCESS OF EMBEDDING ELECTRICAL CONDENSERS

Application filed April 28, 1926. Serial No. 105,121.

This invention relates to the manufacture of electrical condensers and particularly to the solidification or freezing of the insulating filler which constitutes the embedment of an encased sheet condenser. This insulating filler usually consists of a suitable wax, mostly paraffin, or it may be pot-head. Such fillers, during cooling and freezing, contract to a very high degree.

The filler is introduced in molten form into the space between the condenser and its casing; and the object of the invention is to cool and freeze the filler in such manner as to prevent the formation of voids or cracks in the vicinity of high potential portions of the condenser; that is, the object is to freeze the filler holosterically to such distance from the high potential parts of the condenser as to avoid the danger of high potential brushing which occurs in such voids when they exist near the condenser.

The invention consists of the method substantially as disclosed, involving the maintenance of such relation between the amount of heat removed from the molten filler by the casing and by the condenser, respectively, that the filler in the vicinity of the high potential portions of the condenser is frozen outwardly or radially from such condenser portions toward the casing to a distance sufficient to prevent formation of voids in the filler within the danger zone of brushing caused by the application of high potentials across the condenser.

By previous methods of solidifying the embedding filler between condenser and casing, the filler has been supposed to freeze in the above manner, but I have discovered that in those processes, not only did the filler have its interior mass (next the condenser) frozen last, but that the approach of the inner walls of freezing filler inwardly and outwardly toward one another, and contracting while freezing, itself caused the production of the very voids within the danger zone of brush discharge which it is important to prevent and which it had been supposed was being prevented. It was impossible to observe such voids, and inasmuch as the prior processes were supposed to freeze holosterically, the breakdown of resulting condensers was believed to be due to other causes than the brushing in voids; but finally I examined such broken-down condensers and found, contrary to expectation, that voids did exist within the danger zone, and I conceived that the formation of such voids was due to the fact that the freezing of the filler inwardly from the metal casing toward the condenser took place so much more rapidly than the outward freezing from the condenser itself toward the casing, that the two approaching but contracting solid walls of filler approached one another at a location within the danger zone, thereby causing the formation of voids in such zone.

More specifically, the invention, in respect of the amounts of heat removed from the molten filling or embedding fluid by and from the casing and condenser, respectively (and particularly by and from the high potential parts of the condenser), consists in increasing, relatively, the amount of heat removed from the high potential parts of the condenser in proportion to the amount of filler employed; such condenser parts being the very parts around which it is vitally necessary to form a holosteric filler within the danger zone. Thus, the invention consists, generally, in removing a sufficient amount of heat from the molten filler by way of the high potential parts of the condenser, to cause holosteric freezing of the filler throughout the zone of brushing around such high potential parts.

While this relative increase of heat removal by and from the high potential condenser parts (i. e., relative to the heat removed by and from the casing) may be effected by employing a material other than metal for the casing, which is not a good heat conductor (thereby increasing the extent of holosteric filler outwardly from the condenser), yet a metal casing is so frequently most desirable that I prefer to employ it and, therefore, I prefer, not to reduce the absolute amount of heat removed by and from the casing, but to increase the amount of heat removed by and from the high potential parts of the condenser themselves, for a given amount of filler at a given temperature. In some instances, I prefer to decrease the amount of filler which is to be frozen in connection with a given rate of heat removal by the high potential parts of the condenser. In general, I prefer to introduce the molten filler at a lower temperature than heretofore; and in some instances, I prefer to introduce the filler both in small amounts and at a lower temperature than heretofore. And in some cases, I prefer to subject the condenser, and particularly its high potential parts, to the cooling action of convection fluids, such as water circulation or air-blast, for the purpose of increasing the extent of holosteric filler outwardly and radially from such high potential parts.

The drawings assist in disclosing the invention, and of them

Fig. 1 is a central vertical section of a typical condenser to be processed in accordance with the invention;

Fig. 2 is a horizontal section thru the metal casing C of Fig. 1, showing the condenser stack or stacks; and the remaining figures are more or less diagrammatic illustrations of the processing of the condensers of Figs. 1–2;

Fig. 3 being a vertical section of the condenser and certain apparatus of the process and illustrating the process itself;

Fig. 4 being a modification of the process of Fig. 3;

Fig. 5 being a further modification and showing the processing of a plurality of encased condensers;

Fig. 6 being a further modification and showing the processing of a plurality of encased condensers; and

Figs. 7–11 successively showing the steps of a further modification.

As to the scale of Figs. 1–2, a height of four inches is typical for the space to be occupied by the filler, from bottom to top of casing, the other dimensions being in correspondence therewith.

In Figs. 1–2, four sheet-stacks S are shown connected in parallel, this being the clover-leaf type of the patent to Priess, No. 1,499,404 of July 1, 1924. Each stack consists of a plurality of sections separated by mica separators P and connected in series by fusing together the bunches of foils projecting from adjacent stack-sections. Each section preferably comprises alternating sheets of mica and of metal foil. The four stacks S have their inner or high potential ends electrically connected together by a metal block M here cast integral with a high potential stud which extends up and out of the metal casing C centrally thru a hole in the top of the casing. The condenser structure is held in place in casing C by metal pressure plates L, with which engage metal screws N supported in the walls of casing C and highly compressing the stack-sheets together. These outer or low potential ends of stacks S are connected in parallel to casing C as the low potential terminal of the encased condenser. The screws N are used to centralize high potential terminal stud M as to its portion which projects thru the hole in the top of the casing C. The upper end of stud M passes thru a hole in the glass insulating bowl G, which is lead-sealed in the groove in the top of casing C around the central opening therein. Above insulator G is the metal corona shield CS, which is secured around stud M which passes thru it.

The bottom of the condenser is open to permit introduction, first, of the condenser, and, second, of the insulating filler, and after the solidification of the filler in the space between the condenser and the casing, said casing opening is closed by screwing on the bottom cover BC.

The danger zone of brushing is indicated in broken lines Figs. 1–2, and the formation of voids in such zone is extremely undesirable. That is the zone in which the insulating filler has been supposed to be frozen holosterically by prior condenser processes; but I have discovered that that was not the case but that at least to some extent within the danger zone there has been formation of voids by the best of the prior processes used. The prime purpose of using the insulating filler is to prevent such brushing, especially in condensers of such high potential as those shown employing series-sectional stacks; and if voids occur in the danger zone, such prime purpose is defeated.

The processes hereof are improvements on the prior process which consists in introducing the molten filler when the high potential portions, including stud M, are at the bottom of the structure, said process being known in the art as bottom-filling. Hence, herein, as shown in Fig. 3, the filler F1, while molten, is introduced thru the bottom opening in the casing C when the encased condenser of Figs. 1–2 is inverted. It is convenient and customary to design the structure of condensers so that the high potential lead M is normally at the top of the apparatus, but if the condenser were filled when such condenser were upright, the molten filler would not fill completely the very space adjacent the high potential lead which it is important to fill, especially on account of the property of the filler in contracting during freezing. Hence the condenser-inversion of Fig. 3 for the purpose of filling. The word "freezing" is used in this art as applying to the solidification of the filler upon decrease in temperature; altho the processing is effected in ordinary room atmosphere.

In Fig. 3, the space between the condenser (S, S and M) and metal casing C is filled completely with the molten filler, F1. Preferably here, and in the other modifications, the molten filler is at as low a temperature as will permit its wetting of all surfaces, including the surfaces of metal, mica or other portions of the same filling material; so that its fluidity is great enough upon introduction around the condenser to permit it to flow freely into all interstices, particularly along the surfaces of the stacks S, including the spaces between the section-separators P and between the projecting foil bunches F. The lowest practicable temperature consistent with such fluidity of the introduced filler facilitates the operation of my method of holosterically freezing the filler within the danger zone adjacent the high potential parts of the condenser.

In Fig. 3, a tray or tank T, preferably of metal, is provided for the circulation of water or other cooling convection liquid; the tray preferably being provided with input and output means for the water, as shown, for continuous circulation of the cooling liquid thru the tray. Supports U, as shown, are provided for temporarily supporting condenser casing C, in place above tray T, as also in other figures. On these supports the inverted encased condenser is mounted, so that the molten filler at the bottom of the inverted casing and in the glass bowl G is forced by gravity into close contact with the parts around the high potential lead or stud M, and so that in that respect, and with sufficient fluidity of the molten filler, the conditions are correct for proper freezing thruout the vicinity of such high potential parts, provided that other conditions are correct, as they are in the present invention to be described.

In Fig. 3, the high potential stud M itself extends down into the cooling water W, as also does the metal shield CS when employed as it usually is. The latter, being in good heat-conducting relation with metal stud M, greatly facilitates the withdrawal of heat from said stud. The submergence of insulator bowl G in water W under proper conditions will not prevent the holosteric freezing of the filler F1 around the stud M within the danger zone, and in any event such submergence hastens the completion of the freezing of the filler as a whole.

Experience with the method of Fig. 3 proves that the desired result is produced. That is, altho a considerable proportion of the heat in the molten filler F1 is removed via air convection from metal casing C, yet the increase of heat removal via high potential parts CS and M (relative to heat removed by and from the enclosed condenser) results in such an increased extent of holosteric frozen filler outwardly or radially M and CS, before such freezing is met by the freezing inwardly, caused by parts G and C, that there is no harmful formation of voids within the danger zone dotted lines (Figs. 1–2).

In cases where the molten filler may be excessively hot or in very large volume, or both, the glass bowl G may be supported out of contact with water W. Or, as shown in Fig. 4, the filler may be introduced in two stages successively, as at F1 and F2 (distinguished by different cross-hatching). The stacks S themselves have large heat-absorbing capacity, and high potential part M has a large area of heat-transmitting contact with the high potential ends of the stacks. Thus, some of the heat absorbed by M from the first stage of filler, F1, will pass to stacks S, in addition to other heat removed from filler F1 via parts M, CS and water W. And before the introduction of the second filler stage, F2, on top of the first stage of filler, F1, stacks S may be air-blasted, as indicated, to remove such heat from them as rises to them via the portion of metal part M which is surrounded by the first filler stage, F1 (and also for the purpose of cooling the stacks as much as possible in anticipation of the introduction of the second filler stage, F2). Even with the heat removed via insulator G when exposed to air (or even when exposed to water W, as shown in Fig. 4), the cooling effected via metal part M from the first filler stage, F1, is such as to freeze stage F1 holosterically in the danger zone around stud M; this being due to the fact that filler F1 is in such small volume that the freezing by the cooling effected by metal part M is not prevented by a large volume of hot filler from proceeding so rapidly radially outward as to permit formation of voids within the danger zone. While most of the first filler stage, F1, is allowed to freeze before the introduction of the second filler stage, F2, yet the top surface of filler F1 should remain or be fluid at the time the second filler stage, F2, is added, for this results in avoiding a crack at the joint between the two filler stages without the necessity of using sufficiently hot wax for stage F2 to substantially melt the top of the first stage, F1, it being advantageous in the freezing of F2 to employ as low a temperature of F2 as is consistent with having a perfect blend or welding of F1 and F2. If the top of F1 be permitted to freeze solid prior to the introduction of F2, such top surface may be melted by a torch flame to avoid the disadvantage of introducing F2 at a temperature sufficiently high for the same purpose; but the use of the torch is undesirable on account of the liability of injuring stacks S or the series connections of their sections. Hence it is desirable to apply F2 before the top surface of F1 has hardened. In the respects just mentioned, this modification of Fig. 4, or any stage-filling modification of the process, is less convenient than the modification shown in Fig. 3, on account of the necessity in Fig. 4 of careful observation by the operative of the proper time to add the upper filler stage, F2 i. e., when all of the lower filler stage is frozen save its top surface; whereas, in the modification of Fig. 3, where the casing space is completely filled at the beginning of the freezing process, there is no such requirement of careful observation by the operative.

Under such effective cooling of the high potential parts of the condenser as may be obtained by water W on parts M and CS (Figs. 3 and 4) and by air-blasting stacks S before filler stage F2 is introduced, as shown in Fig. 4, it is permissible to accelerate the entire freezing process by air-blasting the sides of casing C, as indicated, in addition to the water-cooling of insulator G, so long as effective heat removal is proceeding via M and CS. All that is necessary, in my process, is to insure the holosteric freezing of the interior portions of the filler within the danger zone around and in the vicinity of the high potential parts of the condenser, before the freezing from the exterior of the filler beginning at the casing, reaches said zone to produce voids therein. So long as that is accomplished, the most rapid exterior freezing is desirable in that it enables more rapid completion of freezing of the entire filler. In the freezing (Fig. 4), of the second filler stage, F2, the air-blasting of the exterior or sides of casing C may be continued advantageously; but it may be desirable in some instances to discontinue the other air-blasting, at the top, i. e., that of the stacks thru the casing opening, because the continuance of such air-blasting at the top might prevent the holosteric freezing of the filler in the danger zone around the high potential central portions of stacks S near the casing filling opening. When the entire filler is frozen and the encased condenser removed from its support U in cooling tray T for reinversion to its normal position, the bottom cover BC is screwed on, the entire device being then ready for service.

Whether the molten filler be introduced all at once as in Fig. 3 or in stages as in other figures, and altho its temperature should be as low as possible consistent with the desired fluidity, yet the volume of the filler, in relation to the amounts of heat removed via the condenser on the one hand and via the casing on the other, should not be so large as to hold sufficient heat to prevent its holosteric freezing within the danger zone around the high potential parts of the condenser. And, similarly, when the filler is introduced by stages, the volume of each stage should not be sufficiently great as to cause the melting (to more than a welding depth) of that portion of a previously introduced stage which constitutes a holosteric embedment within the danger zone.

In Fig. 5 is shown a cooling tank F adapted for simultaneous processing of a plurality of encased condensers; and here is shown the air-blasting of the stacks S thru the casing opening when two stages of filling are employed as in Fig. 4, or when more than two stages are employed as in the remaining figures. That is, the exposed surfaces of the stacks are air-blasted thru the casing opening prior to the introduction of a filling stage covering up the stacks. When any such effective means is employed as here illustrated by the special means for cooling the condenser itself as distinguished from the casing, it is permissible within the invention to remove heat from the casing itself more effectively than by air-blasting the exterior casing walls, i. e., as shown in Fig. 5, the casing itself may be subjected to the action of the cooling water W, provided that care is taken to prevent the water from entering thru the casing opening in the upper part of the drawing. This water-cooling of the exterior of the casing is permissible because the portion of the encased condenser shown as extending into the water is constructed to be water-tight, (this being the part of the apparatus which normally in service is inverted from the position shown in Fig. 5) and because of the effective cooling of the condenser itself via CS and M.

In Fig. 6 is shown a modification in which three stages of filling are employed, it being understood that in any multi-stage embodiment, it is preferable to introduce the upper stage or stages before the top of a lower stage has frozen, in order to permit a good weld between the stages but with the use of such low temperature of the introduced upper filler as will not impair the effect of my process unduly. In Fig. 6, for convenience, the three stages are shown successively in three encased condensers from left to right, but it will be understood that all the condensers in the group-filling of Figs. 5–6 usually will be effected simultaneously. In the encased condenser at the left of Fig. 6, the first stage of molten filler, F1, fills insulating bowl G alone, as in Fig. 4. This volume of filler, even if quite hot, is so small (as compared with the entire space between the condenser and casing) that a minimum of flow of the heat of the filler into the condenser itself (parts CS, M, and S, S) will insure holosteric danger-zone freezing; and in many instances, with the stage-filling, it may not be necessary to employ either water cooling of condenser parts CS or M, or air-blasting of condenser parts S, S or M thru the casing opening, because of such flow of heat into the condenser with resultant holosteric freezing of the filler; and the general process may be accelerated as by cooling the filler inwardly via insulator G and by air-blasting the exterior of casing C, as shown in Fig. 6. All this applies both to the first filling stage, F1, in the left encased condenser, and to the second filling stage, F2, in the middle encased condenser, in both of which may be employed the air-blasting of the stacks S and the end of metal part M thru the open bottom of casing C as shown at the top in Fig. 6. The freezing of the first stage, F1, results in a holosteric filler in the high potential zone around the portion of high potential stud M which extends thru insulating bowl G. The freezing of the second stage, F2, results in a holosteric filler in the danger zone around the rest of the portion of high potential stud M which is exposed from stacks S, S within casing C, and also results in a like freezing of the embedment of the high potential exposed parts of stack S itself which are adjacent stud M, i. e., in the danger zone shown in dotted lines in Figs. 1–2. The second stage, F2, may extend upward vertically, as shown, so as nearly to submerge the stacks S, but not to cover their high potential exposed central portions in the vicinity of metal part M near the casing opening where the molten filler is introduced. The air-blasting of the stacks S up to the time when the second filler stage, F2, is substantially frozen, aids in removing heat from the first and second filling stages, F1 and F2, via the condenser parts, and also cools the stacks in preparation for the third stage, F3. This third stage completes the filling, and stacks S absorb heat from filler F3 adjacent their central high potential portions dotted lines, (Figs. 1–2), so that the holosteric embedment is effected at this portion of the danger zone; the volume of added wax in the third stage, F3, being so small as not to add sufficient heat to prevent the desired holosteric freezing via the heat absorption by the stack, as distinguished from the complete filling of the entire casing space with molten filler without providing special means for removing heat via the condenser parts.

Figs. 7–11 show a modification of the process which has been used in regular manufacture with perfect results, this being a four-stage modification of the stage process and not requiring any other cooling of the condenser parts (the casing may be air-blasted as indicated) than the normal air-convection from condenser parts CS, M and S, S. In fact, this four-stage process is so effective that it permits acceleration of the entire process via such air-blasing of the exterior walls of casing C; and by the expedient of multi-stage filling, even to the extent of more than four stages, it is practicable to obtain holosteric embedment in the danger zone and also such rapid acceleration of the entire freezing process as accompanies such more rapid removal of heat as may be accomplished by the water cooling shown in Figs. 4–5.

The four stages are shown successively in Figs. 7–10. Fig. 11 indicates merely a depression D at the top of the top stage, F4, resulting from contraction upon freezing of that stage; such depression preferably being filled with additional insulating filler prior to screwing on the bottom cover BC (Figs. 1–2). In Figs. 7–10, it is not necessary to water-cool the parts CS or M or to air-blast stacks S. Reliance for obtaining the holosteric freezing of the filler in the danger zone here is placed solely on the effect of the successive introduction of small volumes of not too hot filler which do not prevent the desired holosteric freezing via heat absorption by condenser parts CS, M and S, S and via unforced air convection therefrom. A practical advantage of a multi-stage modification of the process, therefore, is that it does not require any special apparatus for cooling the condenser parts; altho, if desired, and without the use of water cooling means, the stacks S when not covered by the insulating filler may be air-blasted; and even in the multi-stage modifications it is permissible to water-cool the condenser parts CS and M if desired, as in cases where even the relatively small volume of filler in each stage may be large with respect to the extent of cooling of the condenser parts and with respect to the amount of heat removed via casing C; and in any instance, any increase in the rate of removing heat from the condenser parts themselves will permit acceleration of the freezing of the entire filler mass by increase of rate of heat removal via casing C.

In Fig. 7, the first filler stage, F1, fills only glass bowl G, approximately, as in Figs. 4 and 6, and results in holosteric filler embedment in the danger zone around that part of high potential stud M which extends thru said bowl G.

While the exact extent of each of the four stages as described below is ideal, yet it is sufficient if they be followed generally in practice. (It is difficult to insure that the operative exactly follows the ideal details of the process. Preferably, the molten filler is poured in from a receptacle manipulated by the operative and is not supplied thru pipes, and the operative is liable to introduce the filler of the successive stages in quantities which do not result in the exact stage-levels here described.)

In Fig. 8, the second stage, F2, is introduced to a level just below section-separators P and not touching the foil bunches F or the mica dielectric sheets of the stacks. This second stage, therefore, completes the holosteric embedment in the danger zone around that part of stud M which extends above insulating bowl G nearly to the stack of the condenser, but the filler does not reach the central high potential portions of the stacks themselves or that part of stud M which extends toward the stack beyond the section-separators P.

Up to the introduction of the third stage, F3 (Fig. 9) the entire exterior surfaces of stacks S and the projecting foil bunches F (good heat-conductors) are freely exposed to cooling by air-convection, with the result of forming a holosteric embedment in the danger zone around nearly the entire length of stud M which extends between bowl G and a point immediately adjacent stacks S.

In Fig. 9, the third stage, F3, completely embeds the stacks save at their upper surfaces which face the casing opening thru which the filler is introduced. This results (owing to absorption by the stacks themselves, especially via the foil bunches F extending toward bowl G, of the heat of the molten filler just above the frozen second stage, F2) in the desired holosteric embedment of the filler within the danger zone around the central high potential portions of the stacks at and in the vicinity of the point of entrance of stud M into the stacks. The filler of this third stage fills holosterically the interstices between the mica section-separators P and the foil bunches F, and fills the interstices between them and the portions of stud M adjacent the stacks; and the foil bunches F are so cooled owing to the heat-absorbing capacity of the stacks and the relatively small volume of the added molten filler at its lowest practicable temperature, that the danger zone here is solidly filled with the filler without the formation of any voids. In this third stage, also, the lower potential portions of the stacks, including their outer ends, are embedded, and while heat absorption by the stacks causes similar holosteric embedment here, yet that is not necessary but is merely incidental to my process.

Finally, in Fig. 10, the fourth stage, F4, is introduced, and this results in the holosteric embedment of the filler within the danger zone around the high potential portions of the condenser near the casing filling opening (Figs. 1–2). Then follows the finishing step of Fig. 11 above described; and, finally, prior to the screwing on of bottom cover BC (Figs. 1–2), a torch flame is applied over the final top surface of the filler in order to produce a suitable smooth finish.

Usually and preferably in the production of this type of condenser, the stacks or their sneets, before introduction into the casing, have been subjected to certain molten wax treatments and to certain high mechanical pressure processes resulting in squeezing out the wax from between the sheets to the surfaces of the stacks (edges of the sheets); and, after the stacks have been inserted in the casing but prior to the filling operation, the encased condenser, lacking the bottom cover BC (Figs. 1–2) has been subjected to certain molten wax baths under vacua; and all this results in the fact that when the filling operation is commenced, all the surfaces of the condenser and casing are covered with a comparatively thin coating of wax. But such wax-coating is melted by the introduction of the molten filling wax (or other insulating filling) even when the latter is of the lowest practicable temperature, so that such wax-coating does not contribute to the desired holosteric embedment within the danger zone which is produced by the present invention.

Altho the above described four-stage process of Figs. 7–10 has been amply satisfactory for condensers of the type illustrated, yet in any case the multi-stage process may include several more than four distinct filling stages. In the case of any given encased condenser, the number of stages and the amount of filler for each stage will depend on several variables, including the volume of space between the condenser and the casing.

In the type of condenser disclosed, and in the case of a design thereof where the height of the filling space, between the bottom cover BC (Figs. 1–2) and the glass bowl G, is about four inches, the four filling stages of Figs. 7–10 are satisfactory in the absence of any means for abstracting heat from the condenser additional to unforced air-convection from the condenser parts inside casing C; so that, in general, it may be said that such filling without such additional heat removal from the condenser itself may involve a height of filler for each stage of about one inch, save for special instances of tall and slender metal cases.

In any stage-filling modification of the process such as that shown in Figs. 7–10, and irrespective of the absence, as there, of any special apparatus for removing heat from the end of stud M which projects outside of the casing C, it is helpful to air-blast the entire bottom of the inverted casing, including glass bowl G and the metal walls of the casing adjacent thereto, in addition to M and CS, this irrespective of any air-blasting of the side walls of the casing. Such bottom air-blasting has the effect of maintaining the solidification of the first and second filling stages and of preventing them from being melted to an undue extent by the heat of freshly introduced upper molten filler stages; so that after the holosteric freezing of a given filling stage in its portion of the danger zone of brushing, such freezing will not be undone. Incidentally, such bottom air-blasting assists in removing heat from the externally-projecting portion of stud M and shield CS, but, other conditions being as described with respect to Figs. 7–10, this air-blasting is not necessary, particularly if the temperature of the introduced filler stages is not excessively high or their volumes too great.

The advantages of my new process have been described above, but they are summed up in the statement of the fact that without this process condensers are liable to destruction initiated by brushing from the high potential parts of the condenser into voids in the danger zone, but when the invention is employed, the condensers are not subject to that serious defect.

I particularly point out and distinctly claim the part, improvement or combination which I claim as my invention or discovery, as follows:—

1. The method of solidifying the insulating filler around a high potential condenser, which consists in removing a sufficient amount of heat from the filler by way of the high potential parts of the condenser, relative to heat otherwise removed from the filler, to cause holosteric freezing of the filler thruout the danger zone of brushing around said condenser parts.

2. The method of solidifying the insulating filler around an encased high potential condenser having a high potential terminal projecting outside the casing, which consists in subjecting said terminal to the action of a cooling liquid while the filler is in a molten state.

3. The method of solidifying the insulating filler around an encased high potential condenser, which consists in causing absorption of heat from the filler by the condenser while the filler is in molten condition within the casing while conductively removing heat from another portion of the condenser.

4. The method of solidifying the insulating filler around an encased high potential condenser, which consists in freezing the filler outwardly from the high potential parts and thruout the danger zone of brushing prior to the freezing of such portion of the filler inwardly from the casing.

5. The method of solidifying the insulating filler around an encased high potential condenser, which consists in freezing the filler outwardly from the high potential parts thruout the danger zone of brushing while such high potential parts are located at the bottom of the structure.

6. The method of solidifying the insulating filler around an encased high potential capacitor, which comprises freezing the filler outwardly from the high potential parts throughout the danger zone of brushing and conductively removing heat from said high potential parts by connecting at least a portion of said high potential parts to a cooling medium different from that to which the capacitor casing is subjected.

7. The method of solidifying the insulating filler around an encased high potential capacitor, which comprises freezing the filler outwardly from the high potential parts throughout the danger zone of brushing and conductively removing heat from said high potential parts by connecting a high potential terminal to a cooling liquid outside the casing.

8. The method of solidifying the insulating filler around an encased high potential capacitor, which comprises introducing the molten filler into the casing and around the capactor in at least three successive stages and substantially freezing the filler of each stage before introduction of the filler of the next stage, the fillers of a plurality of stages being introduced before enough filler is provided to submerge the capacitor.

9. The method of solidifying the insulating filler around an encased high potential capacitor, which comprises introducing the molten filler into the casing in at least four successive stages and substantially freezing the filler of each stage before introduction of the filler of next filling stage, the fillers of at least three stages being introduced into the casing before the capacitor has been completely submerged.

10. The method of applying an insulating filler to a high potential capacitor which comprises separately pouring a plurality of shallow layers of the filler, and solidifying each previously poured layer before pouring a succeeding layer, the number of layers and their thickness being small enough for the contraction stresses incident upon the solidification of each layer to preclude the formation of cracks within the filler.

In testimony whereof I hereunto affix my signature.

WILLIAM M. BAILEY.