July 27, 1926. 1,594,124

J. E. SHRADER

CONDENSER

Filed Dec. 13, 1920 2 Sheets-Sheet 1

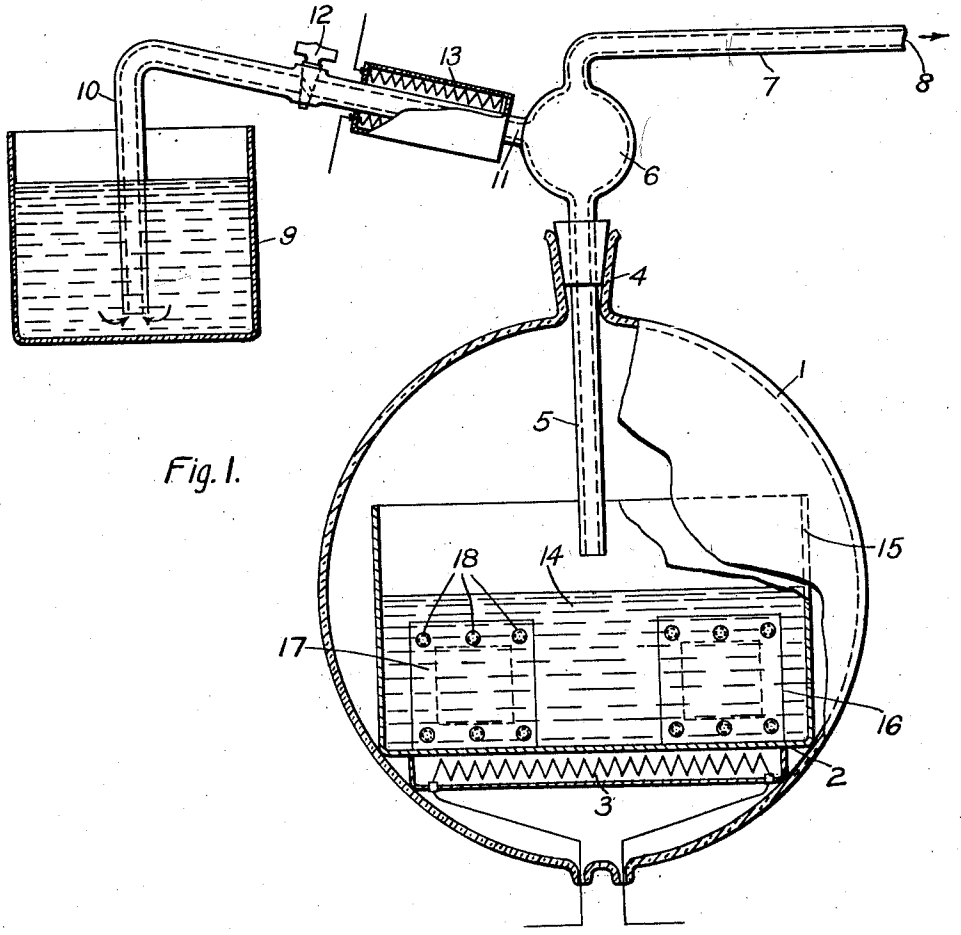
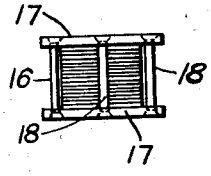


Fig. 1.

Fig. 2.



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Fig. 3.

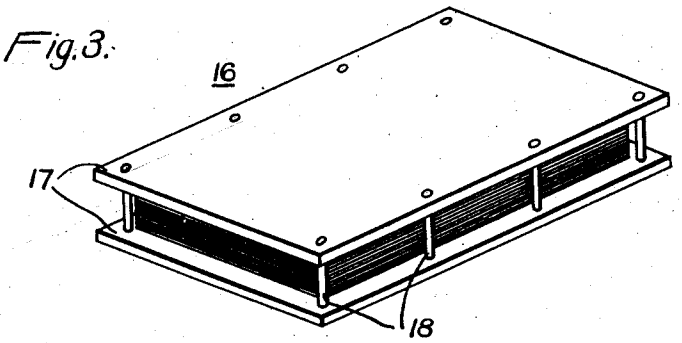
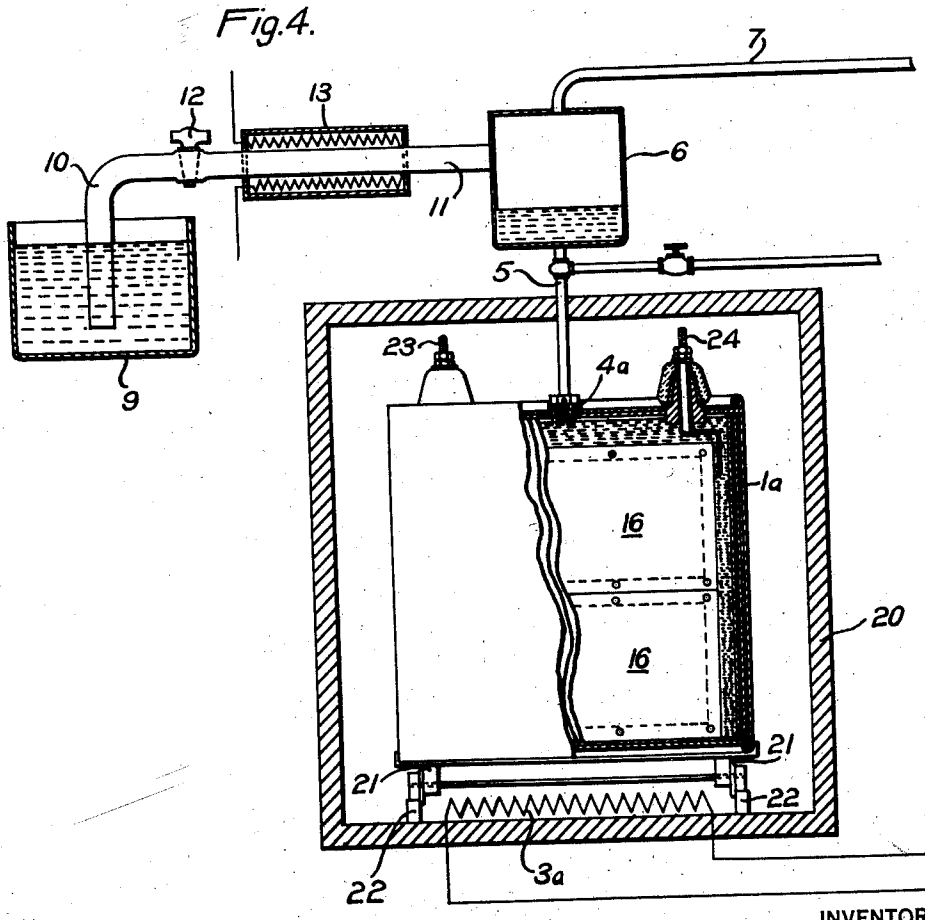


Fig. 4.



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UNITED STATES PATENT OFFICE.

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CONDENSER.

Application filed December 13, 1920. Serial No. 430,369.

This invention relates to condensers, more particularly to a novel method of treating condenser bodies in a more efficient manner than has been practiced hitherto.

Previously, condensers were formed by stacking, rolling or folding alternate sheets of paper or similar material and metal foil until a condenser body of the proper size was produced. The body was then treated by various methods which usually included a heating and drying step and impregnation with a liquid or liquefied dielectric. Generally, some or most of these steps were performed under vacuum or pressure or both. The impregnated condenser body was then clamped to reduce the spaces between the adjacent layers of foil, after which a suitable number of such clamped bodies was assembled in a frame which was placed in the final container. The container was then filled with the same dielectric as that used for impregnating the condenser body.

The above designated method was tedious in that it required a considerable length of time with a number of treatments under various conditions of pressure, vacuum, and heat, and, generally, the product was not entirely free from moisture and gases which reduced the break-down voltage of the condenser and increased its power factor. The assembling of the impregnated condenser bodies by first clamping them, assembling in a frame and then in the final container was very difficult on account of the oil or wax which made the bodies hard to handle, and the procedure was very disagreeable for the operator on account of the splashing of oil or slipping of the condenser body. Due to this subsequent manipulation of the impregnated condenser body, air bubbles and other impurities were very frequently introduced into the condenser, thus lowering its efficiency and life.

My new method obviates the disadvantages inherent in prior methods, it being among the objects thereof to provide a method of forming condensers which shall be simple, efficient and reliable, and one in which the impregnated condenser body need not be handled after impregnation.

In practicing my invention, I form a condenser body by stacking, rolling or folding, as hitherto, and clamp or rivet such condenser body between two plates or sheets of metal to firmly compress the laminations together in the final form. I then proceed with the impregnation which I have found is very complete, even though the condenser body is under great pressure. In prior methods, it was considered necessary for the proper drying and impregnation of the condenser body with the dielectric, such as oil, Montan wax, ceresin, and the like, that the body should remain very loosely stacked during the drying and subsequent impregnation thereof. I have found, on the other hand, that such condition is not at all necessary and that the condenser body may be tightly clamped beforehand without any noticeable interference with the drying of the condenser body and its subsequent impregnation.

My invention further contemplates subjecting the dielectric, such as oil, to heat and vacuum before being allowed to come into contact with the condenser body during the impregnation therepf. Such procedure prevents any material amount of gas or vapor, which is ordinarily contained in the dielectric, from coming into contact with the condenser body, and thus introducing such impurities to the detriment of the efficiency and life of the condenser.

In the accompanying drawings forming a part hereof and which illustrate one embodiment of my invention:—

Fig. 1 is a vertical sectional view through an apparatus adapted to practice my new method,

Fig. 2 is a top view of a condenser body,

Fig. 3 is a perspective view of one of the condenser elements, and

Fig. 4 is a diagrammatical, vertical sectional view showing a modified embodiment of my apparatus.

A chamber 1 of any suitable shape is provided with a stand 2 in which is embedded a heater 3, preferably of the electrical-resistance type. An opening 4 in chamber 1 has a tube 5 leading thereinto, the outer end of tube having an enlargement or chamber 6 thereon communicating by tube 7 to a source of vacuum 8.

A vessel 9 has a tube 10 extending nearly to the bottom thereof, the other end 11 of said tube communicating with chamber 6. A stop-cock or other cut-off means 12 is inserted into tube 10 at any suitable point, and

a heater 13, preferably electrical, surrounds a portion of the tube. A suitable dielectric 14, generally an oil or a wax, is placed in container 9.

A suitable vessel 15, containing a suitable number of condenser bodies 16, is placed on stand 2. The condenser bodies consist of stacked, rolled, or folded alternate sheets of solid dielectric and conducting material formed in the usual manner. Plates 17 are placed on the sides of the condenser body 16 and rivets or other suitable fastening and clamping means 18 draw such plates toward each other to apply the pressure requisite to compress the condenser body to substantially the final dimensions desired therein. Thus, if the condenser comprises metal foils separated by three sheets of paper of 0.4 mils thickness each, the foils, which may be regarded as incompressible, are pressed together until they are separated by 1.2 mils, considerable pressure being required for this purpose on account of the moisture and gases in the paper.

The operation of my new method of impregnating condensers is as follows: a condenser body 16 is formed, as shown in Fig. 2, with the clamping plates in position, exerting the pressure necessary to hold the parts in the relative positions desired in the finally impregnated condenser body. A suitable number of such clamped condenser bodies 16 are placed in vessel 15, the heater 3 is set into operation, and the source of vacuum 8 placed in comunication with chamber 1. The heat and vacuum in said chamber are maintained for a suitable length of time. Usually, about two hours, at a temperature of about 105° C., are required for the preliminary treatment which expels practically all the moisture and gases in the clamped condenser bodies, thus relieving the dielectric from mechanical strains which have heretofore been the result of many breakdowns.

Stop-cock 12 is then opened, causing oil 14 in container 9 to be drawn through tube 10 into chamber 6. In passing heater 13, which is in operation, the oil is heated to a temperature somewhat higher than the temperature of chamber 1 (about 115° to 125° C.,) after which it passes into chamber 6 where the vacuum removes any moisture or gas contained therein. The purified oil then drops through pipe 5 into the bottom of container 15, gradually rising until it covers the condenser bodies therein. The latter operation usually requires about one hour and results in complete impregnation of the thoroughly dried condenser bodies. The removal of the moisture and gases from the dielectric before the impregnation thereof makes possible the impregnation of the condenser body while it is clamped under pressure as just described, thus avoiding the necessity for impregnating the same in a loosely assembled state and subsequently reaching down under the impregnating liquid and tightening the clamping screws of the condenser body after completion of the impregnation, as has been necessary heretofore.

The bodies are then removed and assembled in suitable number on a frame which is placed in the final container filled with oil. If desired, I may initially place the unimpregnated clamped condensers in suitable number on a frame and impregnate the assembly in container 15 or I may place such assembly in the final container which is inserted into chamber 1 for treatment. In many cases, I may dispense with chamber 1 altogether and utilize the final container, in which the condenser body assembly is placed, as the vacuum chamber by placing an air-tight cover thereover during the treatment.

Thus, in Fig. 4 the final tank 1^a, into which a plurality of my condenser units 16 are to be placed, is utilized in place of the vacuum chamber 1 of Fig. 1. The condenser tank 1^a is provided with a threaded opening 4^a to which the evacuating and impregnating pipe 5 is attached. The heater 3^a is, in this case, placed outside of the vacuum tank 1^a and it is preferably enclosed wthin insulating walls 20 constituting an oven having a removable door or end through which the condenser tank 1^a is inserted, as by means of a truck 21 rolling on tracks 22.

In carrying out the process as illustrated in Fig. 4, a number of individual units 16 are inserted in the casing 1^a before the last side or end of the casing is put in place. The respective terminals of the condenser unit 16 are then joined together to the main condenser terminals 23, 24 and the tank 1^a is completely closed and hermetically sealed. The unit is then wheeled into the oven 20 and the evacuating and oil-filling pipe 5 is secured in the opening 4^a in the top of the condenser tank. The evacuation, impregnation and heat treatment is then the same as that previously described. At the end of the treatment, the pipe 5 is removed and the opening 4^a is closed by a suitable plug (not shown) and the condenser tank is ready for final test and shipment.

It will be seen that my new method, which results in a product equally as good as the best product hitherto obtained, is extremely simple and very advantageous in many respects. It permits the final assembly of the clean, unimpregnated condenser bodies in their final containers for heat and vacuum treatment and impregnation and avoids any subsequent handling of the slippery, oil-impregnated condenser bodies, thus making it more pleasant for the operator. By my new

method, much time and labor are saved in the manufacture of condensers and I avoid the possibility of spoiling or injuring the condenser bodies by disturbing the impregnated units in the handling.

By clamping the unimpregnated condenser bodies under final pressure, I am enabled to test such bodies before impregnation for defects in the insulation before treating, and am thereby enabled to eliminate unnecessary treatment of defective condenser bodies. Since the oil used in the impregnation is heat and vacuum treated and hence free from moisture and gases, it eliminates a possible source of moisture and gases, thus increasing the durability and efficiency of the completed condensers.

Although I have described a specific method of impregnating and forming condensers, it is obvious that my invention is not limited to the details set forth, since various changes may be made within the scope of my invention. For instance, although I have mentioned 105° and two hours as suitable for the preliminary treatment of the assembled condenser body, it is obvious that both the temperature and the time may be varied to suit conditions. The temperature used may be as high as can be employed without charring or causing deterioration of the paper, and the time of treatment may also be varied in accordance with the size of the condenser body being treated.

I have found that fifteen minutes to thirty minutes are sufficient for most preliminary treatments but, generally, I prefer a longer time, two hours or more, to make elimination of moisture certain. My heat and vacuum impregnation, although stated to consume about one hour, may obviously be so operated as to take more or less time. These and other changes may be made in my method without departing from the principles laid down in this specification.

I claim as my invention:—

1. A method of forming condensers which comprises forming a condenser body, placing the same in a chamber, applying heat and vacuum thereto, treating insulating material to eliminate moisture and gases, and then impregnating said body with said insulating material.

2. A method of forming condensers which comprises forming a condenser body, placing the same in a chamber, applying heat and vacuum thereto, treating insulating material to eliminate moisture and gases by subjecting the same to heat and vacuum, and impregnating said body with said insulating material.

3. A method of forming condensers which comprises forming a condenser body, placing the same in a chamber, applying heat and vacuum thereto, treating insulating material to eliminate moisture and gases by subjecting the same to heat and vacuum simultaneously with said body, and impregnating said body with said insulating material.

4. A method of forming condensers which comprises forming a condenser body, clamping the same, assembling a suitable number of such bodies in the final container to form a condenser unit, applying heat and vacuum thereto, treating insulating material to eliminate moisture and gases, and impregnating said unit with said insulating material.

5. The method of manufacturing condensers which comprises forming condenser bodies consisting of alternate sheets of unimpregnated solid dielectric and conducting material, clamping the same in individual packages under the final pressure desired therein, testing said bodies for defects in the insulation, subsequently subjecting the successfully tested bodies to a combined heat and vacuum treatment to eliminate gases and moisture, and thereafter causing the same to be impregnated, while still subjected to said heat and vacuum treatment, with an impregnating material which has been heat and vacuum treated to eliminate moisture and gases before it comes into contact with the condenser bodies.

6. The method of manufacturing condensers which comprises forming condenser bodies consisting of alternate sheets of unimpregnated solid dielectric and conducting material, testing said bodies for defects in the insulation, subsequently assembling the successfully tested bodies in a group and subjecting the same to a combined heat and vacuum treatment while under the final pressure desired therein to eliminate gases and moisture, and thereafter causing the same to be impregnated, while still subjected to said pressure and said heat and vacuum treatment, with an impregnating material which has been heat and vacuum treated to eliminate moisture and gases before it comes into contact with the condenser bodies.

7. The method of manufacturing condensers which comprises forming condenser bodies consisting of alternate sheets of unimpregnated solid dielectric and conducting material, clamping the same in individual packages under a substantial pressure to compress the same to substantially the final dimensions desired therefor, subsequently subjecting the bodies to a combined heat and vacuum treatment, and thereafter causing the same to be impregnated, while still subjected to said heat and vacuum treatment, with an impregnating material which has been heat and vacuum treated before it comes into contact with the condenser bodies.

8. The method of manufacturing condensers which comprises forming condenser bodies consisting of alternate sheets of unimpregnated solid dielectric and conducting material, assembling the bodies in a group and subjecting the same to a combined heat and vacuum treatment while clamped under a substantial pressure to compress the same to substantially the final dimensions desired therefor, and thereafter causing the same to be impregnated, while still subjected to said clamping and said heat and vacuum treatment, with an impregnating material which has been heat and vacuum treated before it comes into contact with the condenser bodies.

9. The method of manufacturing an electrical device comprising conductor bodies separated by a solid, impregnatable dielectric, which comprises assembling said device in its final casing under a substantial pressure, subsequently treating the same with heat and vacuum to remove air and moisture and relieve said dielectric from mechanical strains due to the presence of air and moisture, and thereafter causing the same to be impregnated, while still subjected to said heat and vacuum treatment, with an impregnating material which has been heat and vacuum treated to eliminate moisture and gases before it comes into contact with said dielectric.

In testimony whereof, I have hereunto subscribed my name this 4th day of December 1920.

JAMES E. SHRADER.