

PATENT SPECIFICATION

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(54) EQUIPMENT FOR PRODUCING HIGH VOLTAGE RECTIFYING UNITS

(71) We, HITACHI LTD., a Japanese Body Corporate of 5-1, 1-chome, Marunouchi, Chiyoda-ku, Tokyo, Japan, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to an equipment for producing a high voltage rectifying unit. More particularly, the invention pertains to an equipment for producing a cast high voltage rectifying unit by injecting a liquid thermo-setting resin composition and curing the injected resin composition.

The rough structure of a high voltage rectifying unit will be explained below. A high voltage rectifying unit (1) is made up by, as shown in Fig. 1, installing necessary parts such as an inner bobbin (1d) around which a primary coil (1b) is wound, an outer bobbin (1e) around which a secondary coil (1c) is wound, diodes (1f), etc., in a case (1a) of a synthetic resin, carrying out necessary treatments such as wiring, injecting a liquid thermo-setting resin composition (1g) into the assembly, and then curing the injected resin composition to form a fixed structure. Here, the liquid thermo-setting resin composition (1g) bonds these parts fastly and affords required electrical characteristics such as insulating property, voltage resistance, etc. In order that the resin displays its properties enough and affords required characteristics, however, it is necessary for the resin composition (1g) to fill and impregnate even the gaps between the wires wound as a coil without forming air bubbles. The quality of a product depends upon the quality of this treatment, and the method of this treatment is a great factor determining the production cost.

Next, a general equipment for producing a high voltage rectifying unit which has heretofore been performed will be explained. A prescribed number of high voltage rectifying units which have been

assembled so that a liquid thermo-setting resin composition may be injected thereinto (hereinafter referred to as "product") are arranged on a jig, loaded on a truck, inserted into a preheating furnace as it is by hand operation, heated for a definite period of time, and then removed from the preheating furnace by hand operation. Thus, the drying and annealing of the product is carried out. Next, as described in Japanese Patent Kokai (Laid-Open) No. 122,571/74 and Japanese Patent Kokai (Laid-Open) No. 24,665/76, a liquid resin ingredient and a curing agent for injecting are defoamed, stirred and mixed by a stirrer in a vacuum state. The resin composition is charged to a vacuum chamber and defoamed by evacuating. An appointed weight or volume of the resin composition is measured by a meter and injected into said product which has been preheated and inserted into an injection chamber by hand operation as described above. The resin composition-injected product is then removed by hand operation. When the amount of the thus treated products reached a definite amount, these treated products are loaded on a truck and inserted by hand operation into a curing furnace heated according to a prescribed profile, where the products are heated and cured to yield finished products. However, said thermo-setting resin composition used for injecting contains various additives, and some of the resin itself, a mixed solution and the gaseous substances generated may be harmful to a human being. It is not allowable for operators to touch directly these harmful substances or inhale them before the resin is completely cured. Therefore, it has been necessary to take any safety measures in all of the preparatory operation necessary for resin injection, the injection operation, the curing treatment and transportation operations between the respective steps. Although prior art equipments for injecting the liquid thermo-setting resin composition are equipped with a means for measuring,

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mixing and continuously injecting the resin composition, the inside in a vacuum is returned to atmospheric pressure every time the products are supplied or removed and the inside is evacuated from atmospheric pressure to a prescribed degree of vacuum every time the resin composition is injected. Therefore, operation efficiency has been very poor, the operators must carry the products, into which the resin composition has been injected to a certain degree, by hand operation when supplementarily injected, and there have many problems from a viewpoint of said operational environment. Also, since a batch method has been employed in the curing furnace as described above, it has been necessary to control the products in each lot to ensure a correct curing temperature profile and operation control has been difficult. Further, operation efficiency has been very low.

An object of the present invention is to provide an equipment for producing a high voltage rectifying unit wherein the defoaming, measuring and mixing of a resin ingredient and a curing agent, respectively, the vacuum injection of the resulting thermo-setting resin composition into the product, and the defoaming and curing of the resin composition injected into the product can be carried out continuously and automatically, which equipment is closed to isolate the external atmosphere, and is easy in quality control and safe against the toxicity of excellent in operation efficiency.

According to the invention there is provided an equipment for producing a high voltage rectifying unit, which equipment is provided with: a defoaming means for storing and vacuum-defoaming a resin ingredient and a curing agent, respectively, alone; a mixing means for mixing said resin ingredient and said curing agent at a prescribed mixing ratio which is connected with said defoaming means by a closed piping; a vacuum injecting chamber for injecting an appointed amount of the mixed and defoamed thermo-setting resin composition into an assembled high voltage rectifying unit in a vacuum state through injecting nozzles connected with said mixing means by a closed piping, which vacuum injecting chamber is equipped with first carrier apparatus which may load and intermittently carry said high voltage rectifying unit inserted into the vacuum injecting chamber through a gate which may be opened and closed; a curing furnace equipped with second carrier apparatus for carrying the resin composition-injected high voltage rectifying unit through the curing furnace, the curing furnace being adapted for heating and cur-

ing continuously the resin composition-injected high voltage rectifying unit so that an appointed temperature profile may be formed along the carrying route of the second carrier apparatus; and third carrier apparatus for carrying said high voltage rectifying unit from the vacuum injecting chamber to said curing furnace, which third carrier apparatus is covered to isolate the external atmosphere, and in which equipment the procedures from the vacuum injection of the thermo-setting resin composition into the high voltage rectifying unit to the curing of the resin composition can thereby be carried out continuously and automatically.

Preferably the equipment includes a defoaming chamber for defoaming the resin composition injected into the high voltage rectifying unit by evacuating to an appointed degree of vacuum which is provided adjacent to said vacuum injecting chamber and is equipped with fourth carrier apparatus which may load and carry a high voltage rectifying unit inserted from the vacuum injecting chamber through an openable and closable gate.

The present invention will be further apparent from the following description, taken in conjunction with the accompanying drawings, in which:

FIG. 1 is a sectional view of a high voltage rectifying unit produced according to the present invention;

FIG. 2 is a perspective view showing the rough constitution of an example of an equipment for producing a high voltage rectifying unit according to the present invention;

FIG. 3 is an enlarged perspective view of a vacuum injector as shown in Fig. 2;

FIG. 4 is a sectional front view of the vacuum injector as shown in Fig. 3;

FIG. 5 is a sectional view of a curing furnace as shown in Fig. 2;

FIG. 6 shows a temperature profile formed along the transport direction in the curing furnace;

FIG. 7 is an enlarged perspective view of an injector as shown in Fig. 2;

FIG. 8 is an enlarged sectional view of a chamber structure as shown in Fig. 7;

FIG. 9 is an enlarged partially sectional view of a meter as shown in Fig. 7;

FIG. 10 is an enlarged sectional view of a mixer as shown in Fig. 7; and

FIG. 11 is an enlarged sectional view of an injecting nozzle as shown in Figs. 3 and 4.

In Fig. 2, a carrying roller conveyor (2) connects the end of a finished product conveyor (46) with a preheating furnace (3) and rollers (18a) driven by a driving means (not shown) are arranged on the conveyor (2) at appropriate intervals. The preheat-

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ing furnace (3) has a tunnel-type heating means and the carrying conveyor (16) runs through the central part thereof. Since it is required that the carrying speed in the preheating furnace (3) is slower than that in the other places, three rows of the carrying conveyor (16) are arranged in parallel with one another and there is equipped such a means as the successive arrival of a jig (14) can be detected automatically at the end of the carrying roller conveyor (2) and the carried article can be transferred onto said carrying conveyor (16). A preliminary conveyor (4) connects the exit of the preheating furnace (3) with the inlet of a vacuum injector (5) and rollers (18b) driven by a driving means (not shown) are arranged on the conveyor (18b) at appropriate intervals. In Fig. 3 showing the vacuum injector (5), a gate valve (29a) having a gate (21a) which may open or close the path between a vacuum injection preparation chamber (22) and the open air, the vacuum injection preparation chamber (22) connected with a vacuum source, a gate valve (29b) having a gate (21b) which may open or close the path between the vacuum injection preparation chamber (22) and a vacuum injecting chamber (23), the vacuum injecting chamber (23) connected with a vacuum source and equipped with injecting nozzles (6) on its ceiling, a gate valve (29c) having a gate (21c) which may open or close the path between said vacuum injecting chamber (23) and a defoaming chamber (24), the defoaming chamber for further defoaming the thermosetting resin composition, which has been injected into a product, in a vacuum, a gate valve (29b) having a gate (21d) which may open or close the path between the defoaming chamber (24) and a vacuum discharge preparation chamber (25), the vacuum discharge preparation chamber (25) connected with a vacuum source, and a gate valve (29e) having a gate (21e) which may open or close the path between the vacuum discharge preparation chamber (25) and the atmosphere on the discharge side are arranged on a platform (26) in this order and are fixed fastly with each adjacent other to form a closed unified assembly. Each tank is connected with a vacuum pump (not shown) by piping through a valve. In Fig. 4, the gates (21a), (21b), (21c), (21d) and (21e) in the gate valves (29a), (29b), (29c), (29d) and (29e) are suspended by air cylinders (20a), (20b), (20c), (20d) and (20e), respectively, so that the respective gates may be moved up and down. When the respective gates descend, the opening is closed. On the bottom of the respective chambers (22), (23), (24) and (25), a carrier apparatus is provided where- in a rubber belt (27) is stretched between

two pulleys (28). The pulleys (28) in the respective carrier apparatuses are connected directly with a driving means (not shown) so that they may be freely rotated and stopped and time interval rotation may be carried out. The vacuum injection preparation chamber (22), the defoaming chamber (24) and the vacuum discharge preparation chamber (25) each are provided with an inner stop limit switch (30a) which works in agreement with the inserted jig (15) as carried to the end of the chamber on the chamber exit side. The vacuum injecting chamber (23) is equipped with an inner stop limit switch (30b) which works when the inserted jig (15) has been carried to a convenient point for closing the gate (21b). Further, a second inner stop limit switch (31) and a third inner stop limit switch (32) are provided at equal intervals to those of product arrangement in the jig (15). The injecting nozzles (6) are fixed at a position corresponding to the position of a product (1) loaded on the jig when the jig (15) has been stopped for the first time by the working of the inner stop limit switch (30b). Returning to Fig. 2, an injected product conveyor (9) connects the exit of the vacuum injector (5) with a curing furnace (12) and rollers (19) driven by a driving means (not shown) are arranged on the conveyor (9) at appropriate intervals. Part of the conveyor (9) is covered by a barrier dome (10) made of, for example, a clear acrylic resin plate. The barrier dome (10) is connected with one end of a pipe (not shown), another end of which is in turn connected with an air conditioner (not shown) which cleans and exhausts the gas accumulated in the dome (10).

A conveyor (17) runs through the center of a tunnel-type heating means in the curing furnace (12). The heating means is connected with one end of a pipe (not shown), another end of which is in turn connected with an air conditioner (not shown) which cleans and exhausts the gas accumulated in the heating means, as in the barrier dome (10). It takes, for example, about 16 hours for the product to be carried from the inlet to the exit of the curing furnace (12). In the thus arranged heating zones, the products are heated according to the temperature profile as shown in Fig. 6. For example, the curing furnace (12) is made up of eight blocks (12a), (12b), (12c), (12d), (12e), (12f), (12g) and (12h) so that the number of frames may be minimized. Each block is separated into two compartments which are separately subjected to temperature control. Thus, (12a), (12b) and (12c) are high temperature compartments kept at $60^{\circ}\text{C} \pm 5^{\circ}\text{C}$, the righthand half of (12d) and the left-

hand half of (12e) are high temperature compartments kept at $105^{\circ}\text{C}\pm 5^{\circ}\text{C}$, and (12f), (12g) and the lefthand half of (12h) are high temperature compartments kept at $115^{\circ}\text{C}\pm 5^{\circ}\text{C}$. These 16 high temperature compartments are confined and closed leaving a space enough for the conveyor (17) to pass through each compartment together with the jig loaded with the product.

As shown in Fig. 5, the respective high temperature compartments are equipped with heaters on their upper wall, and hot air is circulated from their ceiling to the products as shown by arrows by a fan (49). Returning to Fig. 2, a door (not shown) provided at the inlet of the curing furnace (12) is opened or closed synchronously with a pusher (50) for loading the jig (15) carried by an injected product conveyor (9) onto the conveyor (17) arranged in four rows successively. Also, an air curtain is formed at both the inlet and exit of the curing furnace (12). In order to remove the gas in the curing furnace and reduce the influence of the adjacent high temperature compartment, a forced air supply duct (not shown) is provided in the lefthand half of the high temperature compartment (12a) and a forced exhaust duct (not shown) in the righthand half of the compartment (12h). Further, a fan is provided in the forced exhaust duct. As a result, a slight hot air is circulated from the inlet to the exit of the curing furnace. Air at room temperature is blown into the high temperature compartment on the right of (12c) to reduce the influence of the compartment at 105°C . A finished product conveyor (46) connects the exit of the curing furnace (12) with the end of the carrying conveyor (2) and rollers (46) driven by a driving means (not shown) are provided on the finished product conveyor (46) at appropriate intervals. The jig (15) is a rectangular flat plate which has to be made so that the products can be correctly positioned and fixed in two rows and three lines. In Fig. 7, a resin ingredient tank (33a), a preliminary resin ingredient tank (33b), a curing agent tank (34a) and a preliminary curing agent tank (34b) are all closed containers having an appropriate inlet (51) as shown in Fig. 8. Also, a pipe (52) is connected with a vacuum pump (not shown) and an air compressor (not shown) through a selector valve (not shown). Further, the resin ingredient tanks (33a and 33b) and the curing agent tanks (34a and 34b) each are equipped with an agitator (53), a motor (54) for driving and rotating said agitator, a hand heater (55) for heating the two materials to lower their viscosity and a thermostat thermocouple (56) for measuring the temperature of the two materials and maintaining the

two materials at an appointed temperature by the on-off control of said band heater (55).

Returning to Fig. 7, one end of a resin ingredient pipe (35) is connected with the resin ingredient tank (33a) and the preliminary resin ingredient tank (33b) through a selector valve (not shown), and the other end of the pipe (35) is connected with a check valve (44) for a resin ingredient measuring cylinder (37a). Likewise, one end of a curing agent pipe (36) is connected with the curing agent tank (34a) and the preliminary curing agent tank (34b) through a selector valve (not shown), and the other end of the pipe (36) is connected with a check valve (44) for a curing agent measuring cylinder (37b). The check valve (44) is formed at the lower part of the respective measuring cylinders (37a and 37b) as a unified assembly and has a valve mechanism for sucking the resin ingredient or the curing agent and introducing them into the respective measuring cylinders (37a and 37b). Also, the check valve (44) has a valve mechanism for discharging them from the respective measuring cylinders (37a and 37b) to a pipe (45). The resin ingredient measuring cylinder (37a) and the curing agent measuring cylinder (37b) have a cross-sectional area ratio equal to a mixing ratio, and are engaged with a piston (43) so that the piston (43) may slide through the cylinders. The end of the piston (43) is fixed on a cylinder plate (38), which is fixed on the cylinder rod of an air cylinder (39) fixed on a base (42) (see Fig. 9). Returning to Fig. 7, a mixer (41) is connected with the check valve (44) by the pipe (45). A mixed liquids pipe (7) is connected with an exit side. The intermediate part thereof forms a closed container wherein an agitator blade (57) is supported by a bearing part (58) sealed by an oil seal, etc., so that the blade may be freely rotated. The agitator blade (57) is driven and rotated by an air motor (40). Also, a check valve (59) is provided at the inlet from the pipe (45) (see Fig. 10). An injecting nozzle (6) is connected with the end of the mixed liquids tube (7) and is opened or closed by a valve spool (61) connected with the piston rod of an air cylinder (60). The bearing (62) of the valve spool (61) is sealed by packing. Also, an injecting nozzle (6) is installed on the ceiling plate (65) of the injecting chamber (23) by a nut (63) so that the nozzle (6) may be freely removed or reinstalled. A dispersion-preventing cover (64) is provided at the tip of the nozzle (6) (see Fig. 11).

The operation of the equipment of the present invention will be explained below. The products (1) are first loaded on the jig (15) at the end of the carrying conveyor

(2) so that the products may be correctly positioned in two rows and three lines. Thus, the jig (15) is sent to the preheating furnace (3) and carried at a constant speed in the furnace until the jig reaches the exit of the furnace. The products (1) loaded on the thus carried jig (15) are heated to an appointed temperature, and dried and annealed under suitable conditions for injection. When the jig (15) receives a signal from the limit switch of the vacuum injector (5), the jig (15) is discharged from the preheating furnace (3) and carried to the inlet of the vacuum injector (5) by a preliminary conveyor (4). When the gate valve (29a) of the vacuum injection preparation chamber (22) is opened and the rubber belt (27) is driven, the jig (15) is transferred to the inside of the vacuum injection preparation chamber (22) and touches the inner stop limit switch (30a). As a result, the jig (15) stops automatically together with the rubber belt (27). Thereafter, the gate valve (29a) is opened and the vacuum injection preparation chamber (22) is evacuated to a prescribed degree of vacuum. Thus, the jig (15) is prepared to be carried to the vacuum injecting chamber (23). The vacuum injecting chamber (23) is evacuated under the optimum conditions for the injection and the mixed resin composition is simultaneously vacuum-injected into the products (1) loaded on the jig (15) through the injecting nozzles (6) at a stretch. When the vacuum injection is completed and the vacuum injection preparation chamber (22) reaches the prescribed degree of vacuum, the gate valve (29b) is opened and the rubber belt of the two chambers is driven. Thus, the next jig (15) is transferred to the inside of the vacuum injecting chamber (23) and touches the inner stop limit switch (30b) and stops. Here, the gate valve (29b) is closed and the vacuum injection preparation chamber (22) begins to prepare for receiving the new jig. The vacuum injecting chamber (23) begins to vacuum-inject the resin composition into the products (1) through the injecting nozzles (6) by one operation. The pressure in the vacuum injection preparation chamber (22) is returned to atmospheric pressure. When a difference in pressure disappears, the gate valve (29a) is opened, and a discharge signal is given to the preheating furnace (3). The jig (15) is discharged from the preheating furnace (3), a preliminary conveyor (4) is driven, and the jig (15) is introduced into the vacuum injecting chamber (23). The products (1) on the jig (15) are injected with an appointed amount of the resin composition at the stop position, and the rubber belt (27) is further driven. The belt (27) is stopped by the second inner stop limit switch (31) and injection into the products (1) on the second line is carried out. In the same manner, the rubber belt (27) is stopped by the third inner stop limit switch (32) and injection into the products (1) on the third line is carried out. After the completion of injection into all the products (1) loaded on the jig (15), the jig (15) is sent to the defoaming chamber (4). This transport is carried out simultaneously with the transport from the vacuum injection preparation chamber (22) to the vacuum injecting chamber (23). Thus, the gate valve (29c) is opened simultaneously with the opening of the gate valve (29b), and the respective rubber belts (27) provided in the three chambers are simultaneously driven. When the products (1) enter the defoaming chamber (24) together with the jig (15), the gate valve (29c) is closed and the defoaming chamber (24) is further evacuated to the prescribed degree of vacuum (5 to 10 Torr) to defoam the injected products (1). The defoaming treatment is carried out for the same period of time as the injection time, and the transport of the jig (15) to the vacuum discharge preparation chamber (25) is carried out when the jig (15) is sent from the vacuum injecting chamber (23) to the defoaming chamber (24). Thus, the transport from the vacuum injection preparation chamber (22) to the vacuum injecting chamber (23) is carried out simultaneously with the transport from the vacuum injecting chamber (23) to the defoaming chamber (24). The vacuum discharge preparation chamber (25) acts for keeping always the vacuum injection preparation chamber (22), the vacuum injecting chamber (23) and the defoaming chamber (24) at vacuum and for improving the injection efficiency of the apparatus. The vacuum discharge preparation chamber (25) receives the thus defoamed products (1) in a vacuum state, and partitions from a defoaming chamber (24) by a gate valve (29d) and the pressure in the vacuum discharge preparation chamber (25) is returned to atmospheric pressure. The gate valve (29e) is then opened and the jig (15) is discharged onto the injected product conveyor (9). After discharging, the inside of the chamber is rapidly returned to vacuum and prepared for the next discharging. Due to the above-mentioned structure, the charging and discharging are carried out during injection. The vacuum injecting chamber (23) and the defoaming chamber (24) are always maintained at vacuum, and the jig (15) is continuously treated for a definite period of time and then carried to the inlet of the curing furnace (12) by the injected product conveyor (9). The curing conveyor (17) in the cur-

ing furnace (12) carries the jig (15) at a constant speed. Therefore, the products (1) can be cured according to the prescribed temperature profile (as shown in Fig. 6) while they pass through the furnace. The gaseous substances generated in the procedures from the injection to the curing are all absorbed by an air conditioning apparatus connected with the barrier dome (10), the heating furnace and the vacuum pump (connected in turn with the vacuum injecting chamber (23)). Thus, the working environment can be kept safe. The cured products (1) which have passed the curing furnace (12) are carried back to the start point by the finished product conveyor (46). The finished products (13) are removed, and the uninjected products (14) are newly loaded on the jig (15), which is then transferred onto the carrying conveyor (2) to carry it. Also, at the inlet and exit of the preheating furnace (3) and the inlet and exit of the curing furnace (12), the number of the rows of the jig is successively converted from 1 to 3 or 4 or from 3 or 4 to 1 by the pusher (50) working in response to a switch (not shown) which may detect the arrival of the jig (15).

As described above, according to this equipment, cast high voltage rectifying units can be automatically completed when the jig (15) makes a round. Therefore, the equipment is easy in operation control and excellent in safety.

Next, the injection operation will be further explained. Since a resin ingredient and a curing agent usually contain a large amount of air bubbles, a main tank and a preliminary tank are provided for each of them so that the defoaming treatment of a new material can be performed while the injection is performed. As preliminary tanks are thus provided, the resin ingredient and the curing agent each can be completely defoamed spending a long period of time. For example, an epoxy resin is used as the resin ingredient and an anhydride curing agent is used as a curing agent. When pressurized air is blown into the resin ingredient tank or curing agent tank after the defoaming treatment, the resin ingredient and the curing agent are respectively pressed out into the resin ingredient measuring cylinder (37a) and the curing agent measuring cylinder (37b) through the resin ingredient pipe (35) and the curing agent pipe (36), respectively. Here, the pistons (43) which have been engaged with the respective cylinders are pushed down by the air cylinder (39). Thus, the prescribed amounts of each material are pressed out to the pipe (45) and pass through the mixer (41), where the two materials are mixed. The resulting mixed liquids are sent to the injecting nozzles (6) by way of the mixed liquids pipe (7). When the injecting nozzles are opened corresponding to the working of the air cylinder (39), a definite amount of the mixed liquids is injected through the injecting nozzles (6). Thus, when the piston (43) is pushed down and the valve for the injecting nozzles (6) is opened, the same amount of the material as the amount pressed out is injected into the products (1). When the piston (43) is returned to the original position, the valve for the injecting nozzles (6) is closed and new materials are supplemented into the cylinders (37a and 37b) from the respective tanks through the check valve (44). Thus, continuous injection can be carried out. Particularly, the resin ingredient pipe (35), the curing agent pipe (36), the resin ingredient measuring cylinder (37a), the curing agent measuring cylinder (37b), the mixer (41) and the check valve (44) are closed to isolate the external atmosphere completely. In the respective tanks, the resin ingredient is completely defoamed in 3-5 to 5 hours to a pressure of 2-5 Torr, and the curing agent is completely defoamed in 2 to 4 hours to a pressure of about 1-8 Torr. The resin composition is injected into the products (1) placed in a vacuum atmosphere at 5 to 10 Torr in the vacuum injecting chamber through the injecting nozzles (6) at a slow speed in 30 seconds by one operation. Thus, injection can be smoothly carried out without the overflow or dispersion of the resin composition. Therefore, it is unnecessary to remove the squeezed-out resin composition and it has simplified the automatic operation of the present equipment. Also, since the defoamed resin ingredient and the defoamed curing agent are mixed immediately before the injecting nozzles (6), the route from the mixed to the injecting nozzles wherein the resin composition hardens when the operation of the present equipment is stopped is remarkably shortened. Therefore, the area of the zone to be cleaned is narrow and the operation of the equipment can be readily resumed.

As described above, the procedures from the injection step to the curing step which have heretofore given rise to troubles with regard to safety can be completely automated. Thereby, safety can be ensured and operation efficiency can be remarkably improved. Further, batch treatment steps can be removed and all the steps can be continuously carried out. Therefore, high voltage rectifying units can be produced under all the same conditions, and the quality of high voltage rectifying units can be further stabilized. Also, in the equipment a vacuum injecting chamber and a defoaming chamber arranged adjacent to said vacuum injecting chamber in which

defoaming is carried out at a different degree of vacuum from that in the injection step are provided, and in said vacuum injecting chamber a resin composition in a defoamed state is injected into a high voltage rectifying unit. Therefore, the whole amount of the resin composition can be injected into a high voltage rectifying unit by a stretch substantially without the dispersion of the resin composition. As a result, operation efficiency can be improved and the appearance and the other properties of a high voltage rectifying unit can be remarkably improved. Also, plurality of high voltage rectifying units are loaded on a jig and carried from a vacuum injecting chamber to a curing furnace by a carrier apparatus. It facilitates the transport of high voltage rectifying units in the present equipment and can simplify the attachment and withdrawal of high voltage rectifying units to and from the carrier apparatus, resulting in an improvement in operation effect. Also, since a vacuum preparation chamber is provided before an injecting chamber and after a defoaming chamber, respectively, the time for which the vacuum injecting chamber and the defoaming chamber each must be kept at a vacuum state can be shortened and a high voltage rectifying unit production cycle can be shortened. Also, high voltage rectifying units can be continuously produced only by carrying out the charge of uninjected high voltage rectifying units and the withdrawal of the finished product at one place.

WHAT WE CLAIM IS:—

1. An equipment for producing a high voltage rectifying unit, which equipment is provided with: a defoaming means for storing and vacuum-defoaming a resin ingredient and a curing agent, respectively, alone; a mixing means for mixing said resin ingredient and said curing agent at a prescribed mixing ratio which is connected with said defoaming means by a closed piping; a vacuum injecting chamber for injecting an appointed amount of the mixed and defoamed thermo-setting resin composition into an assembled high voltage rectifying unit in a vacuum state through injecting nozzles connected with said mixing means by a closed piping, which vacuum injecting chamber as equipped with first carrier apparatus which may load and intermittently carry said high voltage rectifying unit inserted into the vacuum injecting chamber through a gate which may be opened and closed; a curing furnace equipped with second carrier apparatus for carrying the resin composition-injected high voltage rectifying unit through the curing furnace, the curing furnace being

adapted for heating and curing continuously the resin composition-injected high voltage rectifying unit so that an appointed temperature profile may be formed along the carrying route of the second carrier apparatus; and third carrier apparatus for carrying said high voltage rectifying unit from the vacuum injecting chamber to said curing furnace, which third carrier apparatus is covered to isolate the external atmosphere, and in which equipment the procedures from the vacuum injection of the thermo-setting resin composition into the high voltage rectifying unit to the curing of the resin composition can thereby be carried out continuously and automatically.

2. An equipment for producing a high voltage rectifying unit according to claim 1, which includes a defoaming chamber for defoaming the resin composition injected into the high voltage rectifying unit by evacuating to an appointed degree of vacuum which is provided adjacent to said vacuum injecting chamber and is equipped with fourth carrier apparatus which may load and carry a high voltage rectifying unit inserted from the vacuum injecting chamber through an openable and closable gate.

3. An equipment for producing a high voltage rectifying unit according to claim 1 or 2, wherein a jig is provided for receipt thereon of a plurality of high voltage rectifying units, said loaded jig being adapted to be carried by said carrier apparatuses.

3. An equipment for producing a high voltage rectifying unit according to any preceding claim, which comprises a preheating furnace for preheating and drying an assembled high voltage rectifying unit and equipped with fifth carrier apparatus for carrying the high voltage rectifying unit through the preheating furnace; a first vacuum preparation chamber formed in a vacuum atmosphere which is equipped with sixth carrier apparatus for inserting the high voltage rectifying unit discharged from the preheating furnace into the first vacuum preparation chamber through a gate which may be opened and closed and carrying the unit to the gate of the vacuum injecting chamber; and a second vacuum preparation chamber formed in a vacuum atmosphere which is provided adjacent to said defoaming chamber and is equipped with seventh carrier apparatus for carrying high voltage rectifying units inserted through a gate into the second vacuum preparation chamber to said third carrier apparatus.

5. An equipment for producing a high voltage rectifying unit according to claim 4, wherein said preheating furnace and said curing furnace are connected by way of the place where the high voltage rectifying

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defoaming is carried out at a different degree of vacuum from that in the injection step are provided, and in said vacuum injecting chamber a resin composition in a defoamed state is injected into a high voltage rectifying unit. Therefore, the whole amount of the resin composition can be injected into a high voltage rectifying unit by a stretch substantially without the dispersion of the resin composition. As a result, operation efficiency can be improved and the appearance and the other properties of a high voltage rectifying unit can be remarkably improved. Also, plurality of high voltage rectifying units are loaded on a jig and carried from a vacuum injecting chamber to a curing furnace by a carrier apparatus. It facilitates the transport of high voltage rectifying units in the present equipment and can simplify the attachment and withdrawal of high voltage rectifying units to and from the carrier apparatus, resulting in an improvement in operation effect. Also, since a vacuum preparation chamber is provided before an injecting chamber and after a defoaming chamber, respectively, the time for which the vacuum injecting chamber and the defoaming chamber each must be kept at a vacuum state can be shortened and a high voltage rectifying unit production cycle can be shortened. Also, high voltage rectifying units can be continuously produced only by carrying out the charge of uninjected high voltage rectifying units and the withdrawal of the finished product at one place.

WHAT WE CLAIM IS:—

1. An equipment for producing a high voltage rectifying unit, which equipment is provided with: a defoaming means for storing and vacuum-defoaming a resin ingredient and a curing agent, respectively, alone; a mixing means for mixing said resin ingredient and said curing agent at a prescribed mixing ratio which is connected with said defoaming means by a closed piping; a vacuum injecting chamber for injecting an appointed amount of the mixed and defoamed thermo-setting resin composition into an assembled high voltage rectifying unit in a vacuum state through injecting nozzles connected with said mixing means by a closed piping, which vacuum injecting chamber as equipped with first carrier apparatus which may load and intermittently carry said high voltage rectifying unit inserted into the vacuum injecting chamber through a gate which may be opened and closed; a curing furnace equipped with second carrier apparatus for carrying the resin composition-injected high voltage rectifying unit through the curing furnace, the curing furnace being

adapted for heating and curing continuously the resin composition-injected high voltage rectifying unit so that an appointed temperature profile may be formed along the carrying route of the second carrier apparatus; and third carrier apparatus for carrying said high voltage rectifying unit from the vacuum injecting chamber to said curing furnace, which third carrier apparatus is covered to isolate the external atmosphere, and in which equipment the procedures from the vacuum injection of the thermo-setting resin composition into the high voltage rectifying unit to the curing of the resin composition can thereby be carried out continuously and automatically.

2. An equipment for producing a high voltage rectifying unit according to claim 1, which includes a defoaming chamber for defoaming the resin composition injected into the high voltage rectifying unit by evacuating to an appointed degree of vacuum which is provided adjacent to said vacuum injecting chamber and is equipped with fourth carrier apparatus which may load and carry a high voltage rectifying unit inserted from the vacuum injecting chamber through an openable and closable gate.

3. An equipment for producing a high voltage rectifying unit according to claim 1 or 2, wherein a jig is provided for receipt thereon of a plurality of high voltage rectifying units, said loaded jig being adapted to be carried by said carrier apparatus.

3. An equipment for producing a high voltage rectifying unit according to any preceding claim, which comprises a preheating furnace for preheating and drying an assembled high voltage rectifying unit and equipped with fifth carrier apparatus for carrying the high voltage rectifying unit through the preheating furnace; a first vacuum preparation chamber formed in a vacuum atmosphere which is equipped with sixth carrier apparatus for inserting the high voltage rectifying unit discharged from the preheating furnace into the first vacuum preparation chamber through a gate which may be opened and closed and carrying the unit to the gate of the vacuum injecting chamber; and a second vacuum preparation chamber formed in a vacuum atmosphere which is provided adjacent to said defoaming chamber and is equipped with seventh carrier apparatus for carrying high voltage rectifying units inserted through a gate into the second vacuum preparation chamber to said third carrier apparatus.

5. An equipment for producing a high voltage rectifying unit according to claim 4, wherein said preheating furnace and said curing furnace are connected by way of the place where the high voltage rectifying

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unit is placed on or withdrawn from said
jig and the high voltage rectifying unit is
circulated starting from said place to effect
the continuous production of the high vol-
5 tage rectifying unit.

6. An equipment for producing a high
voltage rectifying unit constructed and ar-
ranged to operate substantially as herein-

before described with reference to and as
shown by the accompanying drawings.

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