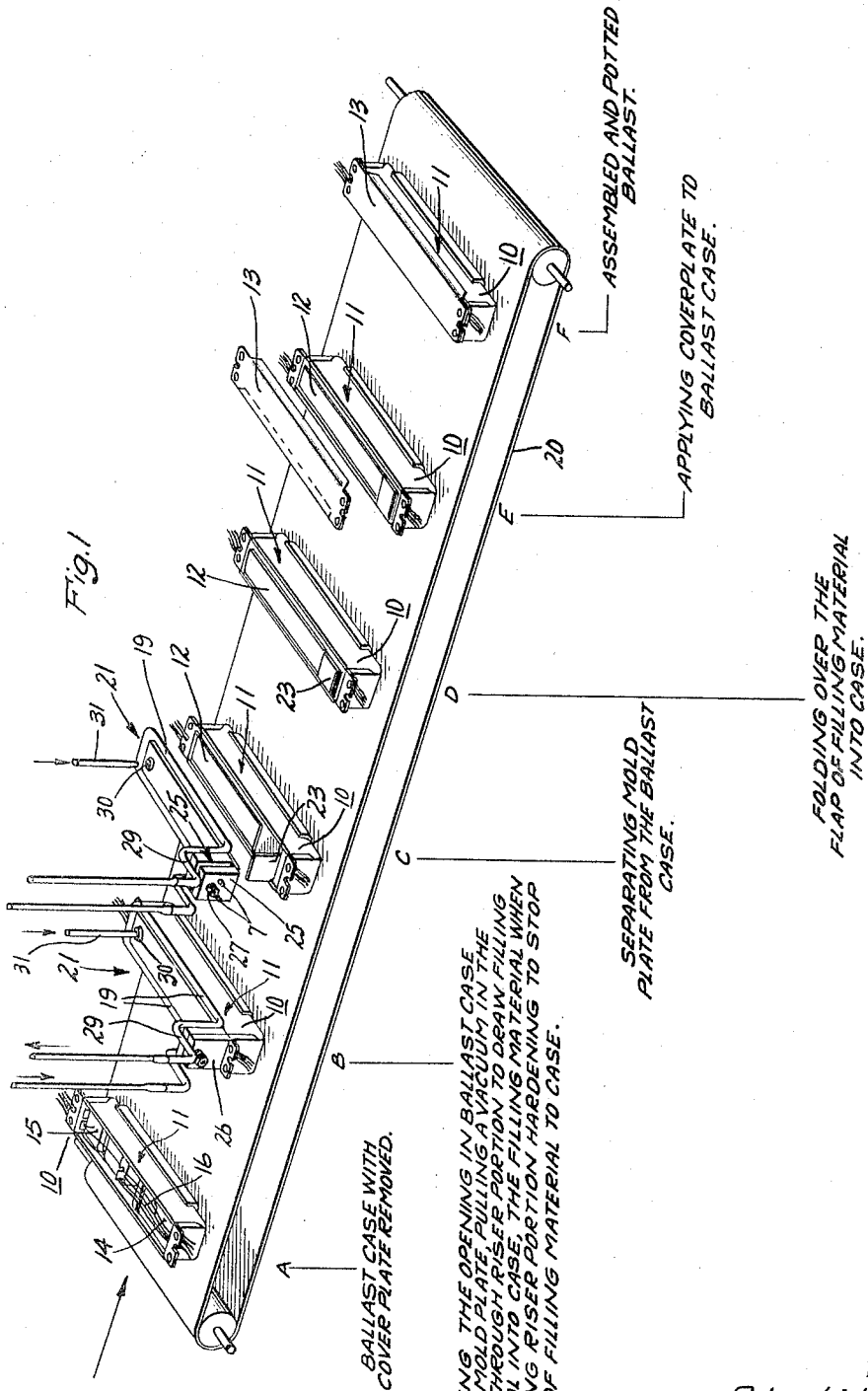
Feb. 21, 1967 R. H. PARSONS 3,305,614

METHOD FOR POTTING ELECTRICAL APPARATUS WITH FILLING MATERIAL

Filed Nov. 5, 1963 3 Sheets-Sheet 1

Fig. 1



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METHOD FOR POTTING ELECTRICAL APPARATUS WITH FILLING MATERIAL

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Fig. 2

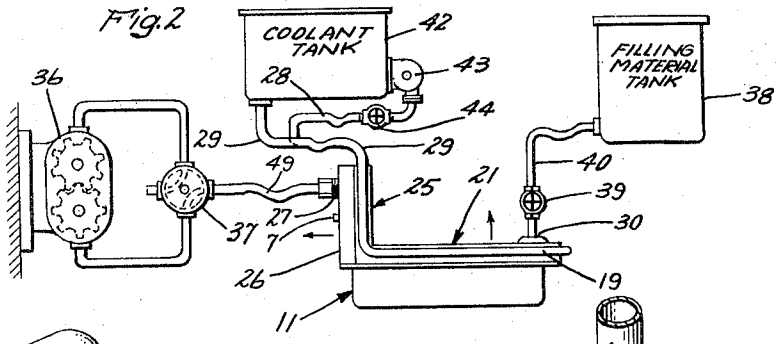


Fig. 3

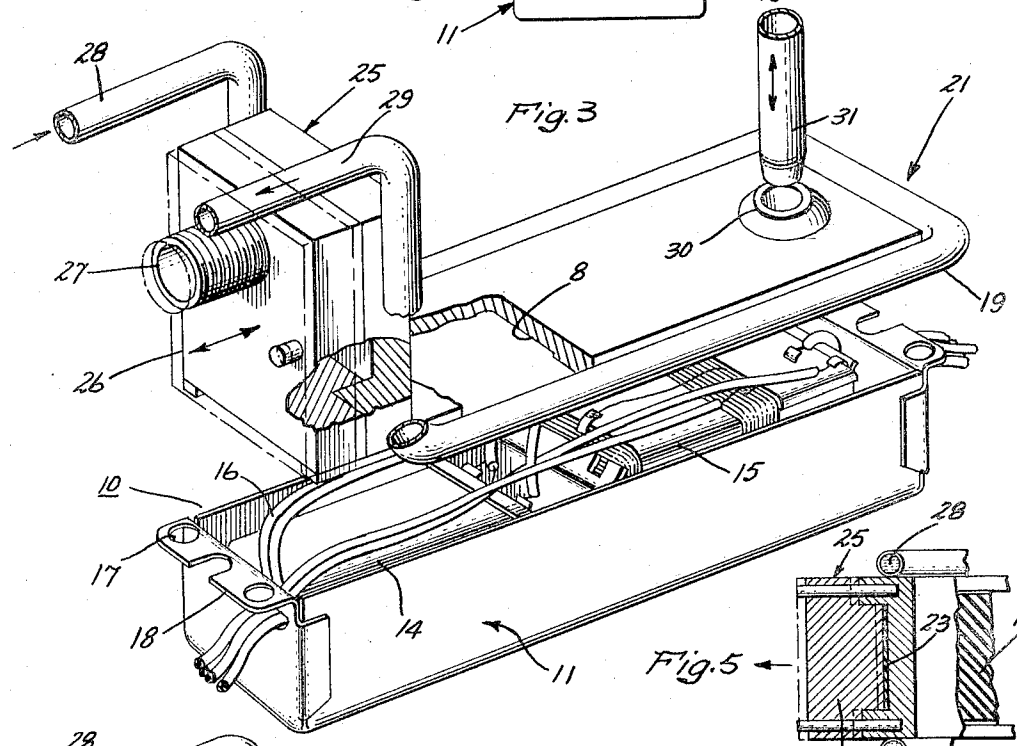
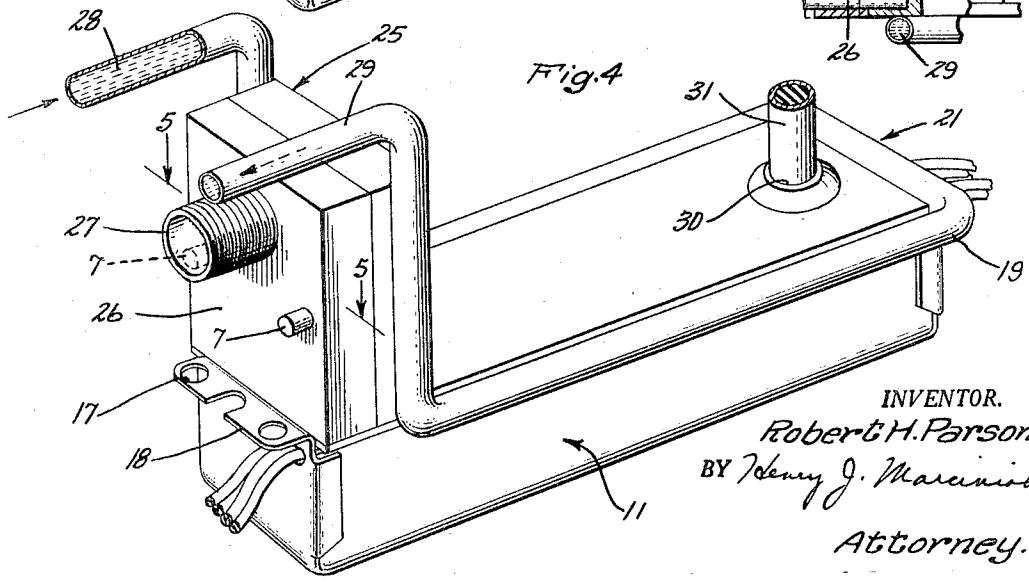


Fig. 5

Fig. 4



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METHOD FOR POTTING ELECTRICAL APPARATUS WITH FILLING MATERIAL

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Fig. 6

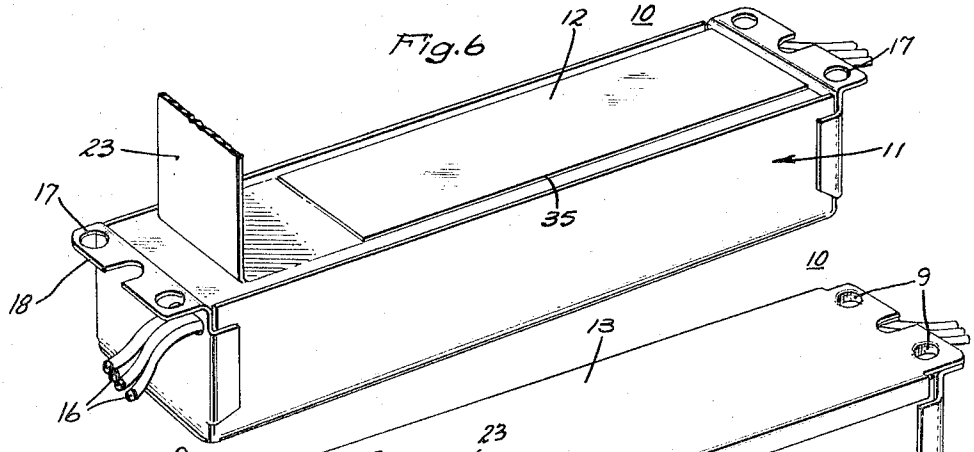


Fig. 7

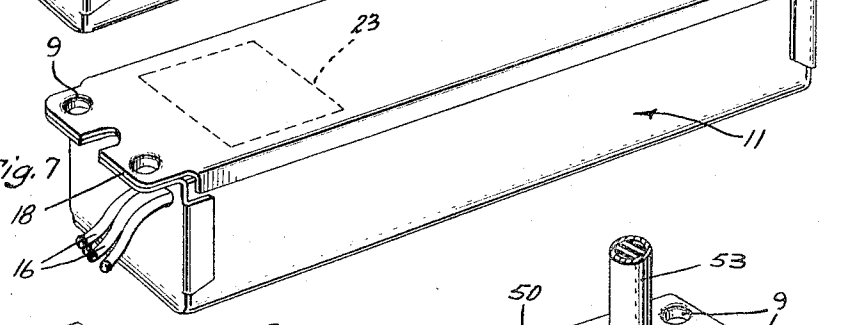


Fig. 8

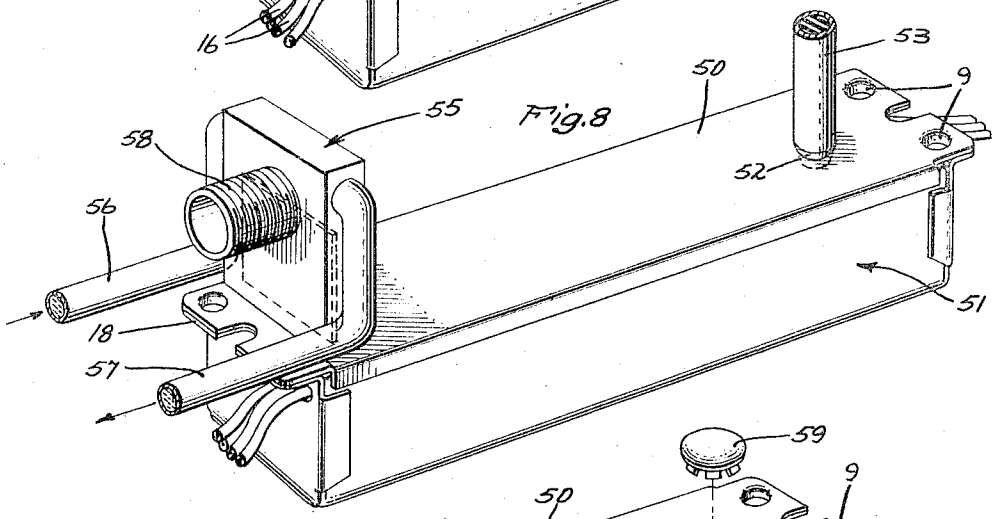
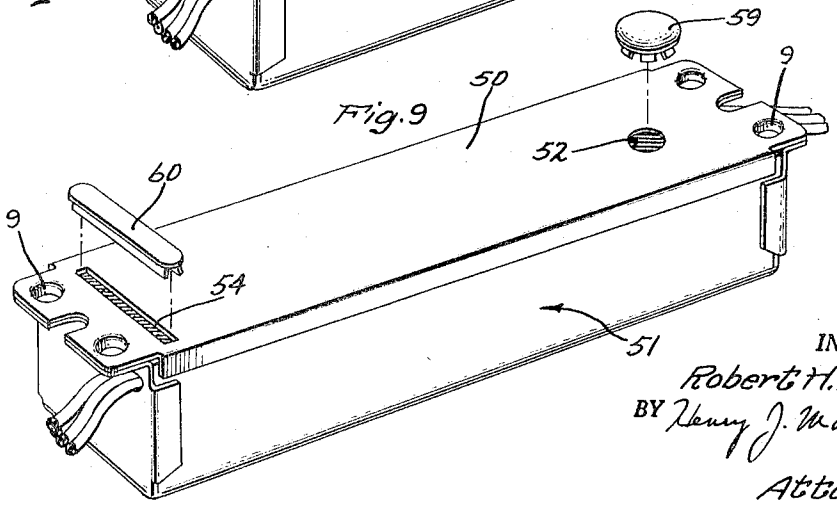


Fig. 9



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United States Patent Office 3,305,614 Patented Feb. 21, 1967

3,305,614

METHOD FOR POTTING ELECTRICAL APPARATUS WITH FILLING MATERIAL

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Filed Nov. 5, 1963, Ser. No. 321,454
7 Claims. (Cl. 264—90)

The present invention relates to methods for potting electrical apparatus in a case with filling material and more particularly, to improved methods that are especially adapted for potting the components of fluorescent lamp ballasts.

Electrical apparatus, such as a ballast for starting and operating fluorescent lamps and other electric discharge devices, is usually enclosed in a metallic case or canister. During the manufacturing process the metallic case serves as a receptacle for the filling material when the components of the apparatus are potted by introducing the filling material into the case. Further, when the apparatus is installed in a fixture or other applications, the case also serves as a protective enclosure for the components and the internal circuit connections. The filling material provides a medium through which the heat produced by the electromagnetic components and other heat generating elements of the ballast can be effectively conducted to the case for dissipation to the fixture on which the ballast is mounted and to the ambient environment. Also, the filling material is used to minimize the noise generated by the electromagnetic components.

According to a conventional method for potting ballasts, the ballast case is initially given a prepour of the filling material before the principal components of the ballast are placed in the case. The core and coil assembly of the ballast and the ballase capacitor are placed into this prepour of filling material while the material is relatively soft and are thereby firmly positioned in the case when the filling material hardens. With the components positioned in this manner, soldering and other assembly operations carried out in order to connect the ballast in operative circuit relationship, can be readily effected.

After the assembly and soldering operations are completed, additional filling material is poured into the ballast case to completely fill the case. In some instances an additional pour may be required to compensate for the shrinkage in the filling material after it has hardened. Unless this is done, voids will occur between the filling material and the coverplate when it is assembled on the case, and these voids will impair the ability of the filling material to conduct heat to the case and to dampen noise developed by the apparatus.

Such conventional methods for potting ballasts have an inherent disadvantage that the level of the potting material in the ballast is difficult to control. When the heated filling material is introduced into the case during the final pour, this must be done quickly in order to prevent hardening of the material that would interfere with good penetration of the heated material around the core and coil assembly and other components of the apparatus. Also, the heated material must completely fill the case. As a result, the filling material frequently spills and splatters the ballast case. Even where the final pour is made under pressure leakage of the filling material may take place through openings in the ballast case.

The relatively hot pouring temperatures of the filling materials used in potting fluorescent lamp ballasts have posed problems in units employing a thermal protective device embedded in the filling material. The thermal protective device is usually actuated at or near the softening temperature of the filling material. During the potting operation, the hot filling material comes in contact with the device. Unless the protective device is designed

to withstand the pouring temperature, the thermal protective device may be prematurely actuated. Accordingly, it is particularly desirable in such ballasts that the pouring temperature be as low at practicable in order to prevent possible premature activation of the thermal protective device.

In my copending application Serial No. 114,855, filed on June 5, 1961, and which issued as United States Patent No. 3,141,049 on July 14, 1964, I have described and claimed therein an improved method for potting electrical apparatus. In this method the case is filled with an overflow of filling material at the top of the case, and the edges of the overflow are hardened to form a confining barrier for the liquid material while it hardens. When the material has sufficiently hardened, the overflow is sliced off. Although this method has been eminently satisfactory in practice, the method has presented problems. In order to shorten the time required to cool the filling material so that the overfill could be sliced, it was necessary to employ a cooling tower. To prevent leads from being accidentally cut during the slicing operation, it was also found necessary, in some cases, to tape the leads before filling to prevent them from being accidentally displaced and cut during the slicing operation. Further, the material removed by slicing must be handled and disposed of. Since these operations increase overall manufacturing costs, there is a need for a potting method wherein taping of the ballast leads and handling of waste material are not required.

Accordingly, it is a general object of the invention to provide an improved method for potting electrical apparatus in a case with filling material.

It is a more specific object of my invention to provide an improved method for potting an electrical apparatus wherein voids between the upper surface of the filling material and the coverplate are essentially eliminated.

A further object of my invention is to provide an improved method for potting a ballast apparatus wherein the case can be completely filled in a single pouring operation without need for slicing off an overfill of the material.

It is still a further object of my invention to provide an improved method for potting fluorescent lamp ballasts that can be carried out at relatively lower temperatures as compared with conventional methods for potting ballasts.

Another more specific object of the present invention is to provide an improved method for potting a ballast with filling material containing asphaltic compound wherein spillage and leakage of the material is minimized.

In accordance with one form of the invention, a mold plate is applied over the opening of a case which houses a fluorescent lamp ballast. The mold plate has a riser portion connected to a vacuum source and a fill aperture through which filling material is drawn into the case. At least, the riser portion is cooled, and preferably, the entire mold plate may be cooled if the filling material has asphaltic constituents. While the mold plate is cooled, the case is subjected to a vacuum through the riser portion to draw filling material into the case through the fill aperture. When the filling material rises into the riser portion, the material in the riser portion hardens due to the cooling, thereby determining when the case is full, and the vacuum to the case and the supply of material are cut off by the hardened material in the riser portion. The mold plate is removed, and a coverplate is then attached to the case.

According to another aspect of the invention, the coverplate of the case used to house the apparatus is fabricated with a vacuum aperture and a fill aperture. The fill aperture is connected to a supply of filling material through

a nozzle. The case is subjected to a vacuum through a riser connection applied at the vacuum aperture to draw filling material into the case while cooling the riser connection. When the filling material rises into the riser connection, the material in the riser connection hardens and thereby causes the supply of vacuum and filling material to be cut off. Thus, the hardening of the material in the riser connection determines when the case is filled. The riser connection and the nozzle are then disconnected from the case, and the fill and vacuum apertures are capped.

The subject matter which I regard as my invention is set forth in the appended claims. The invention itself, however, together with further objects and advantages thereof may be better understood by referring to the following description taken in connection with the accompanying drawing in which:

FIGURE 1 is a diagrammatic illustration of the improved method embodying one form of the invention as applied to fluorescent lamp ballasts;

FIGURE 2 is a simplified schematic illustration of the apparatus employed in conjunction with the mold plate used in the potting method illustrated diagrammatically in FIGURE 1;

FIGURE 3 is an enlarged view in perspective of the mold plate shown in position over a ballast prior to the potting operation;

FIGURE 4 is an enlarged view in perspective of the mold plate assembled on the ballast;

FIGURE 5 is a fragmentary sectional view of the mold plate taken along line 5—5 of the mold plate shown in FIGURE 4;

FIGURE 6 is an enlarged view in perspective of the ballast after it has been removed from the mold plate;

FIGURE 7 is an enlarged view in perspective of the ballast with the coverplate assembled on the case;

FIGURE 8 illustrates a modification of the improved method wherein the coverplate of the ballast case is used as the mold plate; and

FIGURE 9 shows the ballast of FIGURE 8 after the vacuum and fill connections have been removed with buttons in position for sealing the fill and vacuum apertures.

In the illustrated embodiment of the invention shown in FIGURES 1–7, the steps of the improved method are carried out to pot the components of a ballast **10** by filling a case **11** with an asphaltic filling material **12**. The potting operation is performed before the coverplate **13** of the case **11** is assembled thereon, as will be seen at stations A and B illustrated in FIGURE 1.

The ballast **10** is shown in FIGURE 1 on a conveyor **20** to illustrate diagrammatically the sequence of the various operations performed. At station B I have shown a mold plate **21** in position on a ballast case **11**, and at station C the mold plate **21** is shown in an elevated position over the ballast case **11**. After the mold plate **21** has been removed from the ballast **10**, it will be noted that a hardened flap **23** of filling material is left standing. This flap **23** is folded over into the case **11** as shown at station D. The coverplate **13** is then applied to the case **11** as shown at stations E and F.

The ballast **10** includes a capacitor **14**, a core and coil assembly **15**, and various leads **16** that connect the components in operative circuit relationship. As is best seen in FIGURE 3, the ballast case **11** has four sides, a bottom side and a top opening, on which the coverplate is attached by eyeletting the coverplate to the openings **17** provided in the flanges **18** formed on the sides of the case **11**.

Having more specific reference to FIGURES 2 to 5, I will now more fully describe the several steps of the improved method and the apparatus used to carry out these steps. As is shown in FIGURES 2 to 5, the mold plate **21** includes a riser portion **25** having a movable member **26** supported on the guide pins **7** and having a nipple **27** for connection to a vacuum source. The mold plate **21** also includes an inlet **28** and an outlet **29** for cooling fluid, and a fill aperture **30** adapted to receive a nozzle **31**.

In the illustrated exemplification of the invention the mold plate **21** was cooled with a cold antifreeze solution supplied to the inlet **28**. Although in the exemplification of the invention the mold plate **21** was moved up and down to engage the ballast case **11**, it will be appreciated that the mold plate **21** can be fixed, and the ballast case **11** can readily be raised to engage the mold plate **21**.

In some instances it may be desirable, if not necessary, to open the movable member **26** to release the flap **23** from the riser portion **25**. As will hereinafter be more fully explained, preferably, a supply of air under pressure is supplied through the nipple **27** and the movable member **26** is disengaged from the riser portion **25** to facilitate the release of the hardened flap **23** from the riser portion **25**.

The mold plate **21** was formed with an undercut **8**, as will be seen in FIGURE 3, in order to provide for a slight amount of overfill **35**, as shown in FIGURE 6, to compensate for shrinkage in the filling material **12**. In the exemplification of the invention this overfill **35** amounted to approximately $\frac{1}{16}$ of an inch. Although the overfill **35** has essentially a rectangular cross section, a rounded or a concave cross section may be provided, as may be necessary, to compensate for shrinkage of the filling material **12**.

Having more specific reference to the schematic diagram of FIGURE 2, I will now describe the apparatus connected to the mold plate **21**. It will be seen that the nipple **27** of the riser portion **25** is connected to a vacuum pump **36** through a control valve **37**. When the control valve **37** is in one position, as shown, the riser portion **25** is connected to the suction side of the vacuum pump **36**. For the reverse position of the control valve **37**, the riser portion **25** is connected to the discharge side of the pump **36**, and an air pressure is supplied to the riser portion **25** to facilitate the release of the flap **23** and the ballast **10** from the mold plate **21** when it is removed from the ballast case **11** upon completion of the pouring operation. Also, preferably the movable member **26** is moved outwardly when the mold plate **21** is separated to facilitate the removal of the flap **23** from the riser portion **25**.

The nozzle **31** is connected to a filling material supply tank **38** through a stop valve **39**. The valve **39** is provided in the supply line **40** to prevent the filling material from pouring out of the tank **38** when the case **11** is withdrawn from engagement under the mold plate **21**. Where the filling material must be heated, to liquefy the material, such as is the case where an asphaltic type of material is used, a heating element (not shown) is employed in the tank **38** to heat the material to the desired pouring temperature. When the mold plate **21** is separated from the ballast **10**, the fill nozzle **31** is preferably raised out of contact with the fill aperture **30** to prevent material in the fill nozzle **31** from hardening.

In the exemplification of the invention the filling material contained asphaltic compounds and was heated to a temperature between 180 and 185 degrees centigrade. It will be appreciated that where such a material is poured directly into an open case, it ordinarily must be heated to a temperature ranging from 190 to 210 degrees centigrade. The higher temperature is required in order to obtain satisfactory penetration of the filling material into and around the components of the ballast. The material used in the exemplification of the invention was sufficiently fluid at a temperature ranging between 180 and 185 degrees centigrade to provide the desired penetration and hardened to a relatively plastic mass when cooled to room temperatures.

It will be appreciated that the filling material used in a ballast should have suitable thermal conduction characteristics. Heat is generated in the ballast coils due to the copper losses generated by the current flow, and heat is also generated in the magnetic core due to the core losses. An important function of the filling material **12** in the case **11** is to provide a medium for the transfer of

this heat to the case 11 and to the ambient environment in which the ballast 10 is located. It is important, also, that the material 12 completely fill the case 11 to prevent air voids from occurring that might impair the conduction of heat generated by the ballast 10 to the lighting fixture and to the ambient environment. An advantage resulting from the overfill 35 is that a better path for heat flow to the coverplate 13 and to the lighting fixture is provided since the coverplate 13 when attached to the case 11 is pressed against the overfill 35 and brought in intimate contact with the filling material 12.

Although in the embodiments of the invention described herein a filling material 12 containing asphaltic constituents was used, it will be appreciated that other suitable materials may also be used in the practice of the invention. A low pouring temperature is particularly desirable since pouring at a low temperature minimizes the possibility of damage to the components of the ballast 10. This is especially important in ballasts utilizing thermal protectors of the nonresetting type, which might be activated by prolonged contact with the filling material during the pouring operation.

Continuing with the description of the apparatus shown in FIGURE 2, it will be seen that the inlet 28 and outlet 29 of the mold plate are connected to a coolant circulating system which includes a tank 42, a pump 43, and a valve 44. The coolant tank 42 has a refrigerating coil (not shown) that maintains the coolant at the desired temperature, which in the exemplification of the invention was −10 degrees centigrade. It will be noted that the coolant is circulated through tubing 19 which essentially surrounds the mold plate 21 and the riser portion 25 thereby chilling these parts. Although an antifreeze solution was used as a coolant in the exemplification of the invention, it will be appreciated that other coolants, such as a brine solution, may be used to chill the mold plate 21.

In accordance with one form of the invention, the ballast 10 is filled with the asphaltic material by applying the mold plate 21 over the opening in the ballast case 11, subjecting the case 11 to a vacuum through the riser portion 25 while chilling the mold plate 21 and admitting a supply of filling material to the case 11. Air in the case 11 is evacuated as the filling material is drawn into the case 11. When the filling material rises into the riser portion 25, the material in the riser portion 25 is chilled by the brine circulating in the mold plate 21 and hardens sufficiently to cut off the vacuum to the case 11 and to stop the flow of filling material from the tank 38. The hardened filling material 23 in the riser portion 25 also prevents the filling material from being drawn into the vacuum line 49. Thus, the hardened material 23 effectively functions as a valve that closes when the case 11 is completely filled.

In order to prevent spillage of the filling material when the mold plate 21 is separated from the ballast case 11, the valve 39 is turned off. Also, the position of valve 37 may be reversed so that the riser portion 25 is connected to the discharge side of the pump 36, and an air pressure is supplied to the riser portion 25 to facilitate removal of the flap 23. In some applications it may be further desirable to open the riser portion 25 to effect the removal of the flap 23. Since the entire mold plate 21 is chilled, the filling material in the case 11 adjacent to the mold plate 21 hardens. This provides the advantage that the asphaltic filling material will not stick to the mold plate 21 upon removal and the mold plate 21 can be readily separated from the case 11 and reused without need for frequent cleaning. Also, an important advantage resulting from the preferred cooling arrangement is that the cooling cycle for the material in the ballast case is shortened. Thus, the possibility of damage to the ballast components because of prolonged contact with the hot filling material is minimized. To prevent the material in the fill nozzle 31 from hardening, the fill nozzle 31 is raised

out of contact with the mold plate 21 when the mold plate 21 is separated from the ballast 10.

Preferably, the flap 23 formed by the riser portion 25 is shaped so that it folds over into the case and forms a part of the fill. This provides the advantage that the need for handling and cutting off of the flap 23 is eliminated. As will be apparent to those skilled in the art, the flap 23 may be molded to other configurations if desired and the top surface of the filling material 12 in the case 11 may be molded to accommodate the flap 23 when it is folded over into the case 11. It will be appreciated that the flap 23 may be readily folded over by applying the coverplate 13 in assembled relation on the case 11. Preferably, the coverplate 13 is immediately attached to the ballast case 11 after the mold plate 21 is separated from the ballast 10. This results in the important advantage that better adhesion is achieved between the coverplate and the filling material 12. Also the need for storage space in the production line to handle the ballasts that are cooling is eliminated as compared to methods where it is necessary to cool the filling material and slice off the overfill of material before the coverplate can be applied.

In order to prevent the material in the fill nozzle 31 from hardening, the fill nozzle 31 is raised above the mold plate 21 so that it is out of contact with the mold plate 21 when the mold plate 21 is separated from the ballast 10. It will be appreciated that prolonged contact between the fill nozzle 21 and the chilled mold plate 21 might cause the material in the fill nozzle 31 to harden to a degree where it might plug the fill nozzle 31.

In FIGURE 7 I have shown the assembled and potted ballast 10. Although in the illustrated embodiment the coverplate 13 was attached to the ballast case 11 by snapping the eyelets 9 formed in the coverplate 13 against the flanged portions of the ballast case 11, it will be appreciated that the coverplate 13 may be attached to the case 11 by other suitable fastening means.

In FIGURES 8 and 9 I have shown a modification of the invention wherein a coverplate 50 serves as the cover means for the ballast case 51 during the pouring operation. The coverplate 50 is formed with a fill aperture 52 for receiving a nozzle 53 and a vacuum aperture 54 for receiving the riser 55. It will be seen that the riser 55 includes a coolant inlet 56 and outlet 57 and a nipple 58 for connection to a vacuum source.

To fill the ballast case 51, the coverplate 50 is initially attached thereto before the pouring operation, and the riser 55 and the nozzle 53 are brought into engagement with the vacuum aperture 54 and the fill aperture 52, respectively. While the riser 53 is chilled, a vacuum is supplied through the nipple 58 to draw the filling material into the case 51 through the fill aperture 52. When the case 51 is completely full, the material enters the chilled riser 55 and hardens to block off the supply of vacuum to the case 51. Thus, the supply of filling material is blocked off.

Before the case 51 is disengaged from the nozzle 53 and riser 55, the supply of filling material to nozzle 53 is turned off. After removal of the ballast case 51, the buttons 59 and 60 are snapped into the apertures 52 and 54. By applying a pressure at the nipple 58, the hardened material trapped in the riser 55 may be blown out.

From the foregoing description it will be apparent that an improved method has been provided wherein complete filling of the case of an electrical apparatus, such as a fluorescent lamp ballast, is efficiently and economically achieved. Since the apparatus is filled with a cover means in place, splashing and leakage of the filling material, are effectively eliminated thereby enhancing the safety of the manufacturing operation and the quality of the end product. Other important advantages achieved are that it is possible to achieve faster filling of the cases and that the method is readily adaptable to semiautomated assembly lines because of the improved arrangement for stop-

ping the flow of material when the case is completely filled.

Although I have described herein embodiments of the invention for the purpose of exemplification, it will be appreciated that these embodiments may be changed and varied without departing from the principle of the invention. It is to be understood, therefore, that I intend by the appended claims to cover all such changes and modifications that fall within the true spirit and scope of the invention.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. A method for potting a fluorescent lamp ballast in a case with filling material, said case having an opening and a coverplate for closing said opening, said filling material hardening when cooled, said method comprising the steps of: closing the opening in the case with a mold plate, said mold plate having a riser portion connected to a vacuum source and having a connection to a supply of filling material, cooling said mold plate, subjecting the case to a vacuum through the riser portion of said mold plate to draw filling material into the case, said filling material in said riser portion hardening to stop the flow of filling material, causing the mold plate to be separated from the case, and attaching the coverplate to the case.

2. In a method for potting electrical apparatus in a case with filling material, said filling material hardening upon cooling and said case having an opening for receiving the components of said electrical apparatus, the improvement comprising the steps of: closing the opening in the case with a cover means, said cover means having a vacuum connection communicating with the case and a fill aperture for receiving a supply of filling material, and pulling a vacuum in the case through the vacuum connection to draw the filling material into the case through the fill aperture while simultaneously cooling at least said vacuum connection, said filling material when rising into said vacuum connection hardening to stop the flow of material into the case.

3. In a method for potting electrical apparatus in a case with filling material, said filling material hardening upon cooling, said case having an opening, the improvement comprising the steps of: closing the opening with a cover means, said cover means having a vacuum connection communicating with the case and a fill aperture, pulling a vacuum through the vacuum connection to draw the filling material into the case, connecting said fill aperture with a supply of filling material, cooling at least said vacuum connection, said filling material hardening in said vacuum connection to cut off the source of vacuum to the case and stop the supply of filling material thereto, and said hardening of the filling material in said vacuum connection thereby determining when the case is filled with said filling material.

4. In a method for potting the components of an electrical apparatus in a case with filling material, said filling material hardening when cooled and said case having an opening, the improvement comprising the steps of: closing the opening of the case with a cover means, said cover means having a fill aperture and a vacuum aperture, pulling a vacuum in the case through a riser connection at said vacuum aperture and cooling at least said riser connection, and connecting said fill aperture with a supply of filling material, said filling material when rising into said connection hardening and shutting off the vacuum to the ballast case to cause the supply of filling material to the case to be stopped, and said hardening of the filling material in said connection thereby determining when said case is completely filled.

5. In a method for potting a ballast in a case with filling material containing asphaltic constituents, said case having four sides, a bottom and a top opening for receiving the components, the improvement comprising: closing the top opening with a cover means, said cover means having a first aperture for receiving a supply of filling material and a second aperture for receiving a connection to a vacuum source, admitting a supply of filling material through the first aperture while pulling a vacuum through the connection with the second aperture to draw the material into the case, and cooling at least said connection, to cause the filling material therein to harden, said hardening of the filling material in said connection causing the vacuum to the case and the supply of filling material to be shut off thereby determining when filling of the case is complete.

6. In a method for potting a fluorescent lamp ballast in a case with filling material, said case having an opening for receiving the components of the ballast and a coverplate for closing said opening, and said filling material hardening when cooled, the improvement comprising: closing the opening in the case with a mold plate, said mold plate having a riser portion connected to a vacuum source and a connection to a supply of filling material, pulling a vacuum in the case through said riser portion to draw filling material into the case while cooling at least said riser portion, said filling material when reaching said riser portion hardening therein to form a relatively thin flap to stop the flow of filling material, causing the mold plate to be separated from the case and said flap, folding said flap over the filling material in the said case, and attaching the coverplate to the case.

7. In a method for potting the components of an electrical apparatus in a metallic case with filling material, said filling material hardening when cooled, said case having an opening adapted for receiving said components and a coverplate for closing said opening, the improvement comprising: closing the opening in the case with a mold plate, said mold plate having a riser portion connected to a vacuum source and also having a connection to a supply of filling material, chilling said mold plate to a temperature at which said filling material will harden upon contact therewith, pulling a vacuum in the case through the riser portion to draw the filling material into the case through said connection, said filling material in said riser portion hardening to form a thin flap of filling material to stop the flow of material to the case, causing the mold plate to be separated from said case and said flap, and folding over said flap on to the filling material within the case, and attaching the coverplate to the case.

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