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Freegard et al.

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[45] **Feb. 29, 1972**

[54] WEATHERPROOF UNPOTTED BALLAST CONSTRUCTION

[72] Inventors: **Ernest M. Freegard**, Evanston; **Sol Hasson**, Skokie, both of Ill.

[73] Assignee: **Advance Transformer Co.**, Chicago, Ill.

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[52] **U.S. Cl.** ....**317/100**, 317/99, 174/DIG. 2, 174/52 R

[51] **Int. Cl.** **H05k 5/04**

[58] **Field of Search** ....317/99, 100, 120; 174/DIG. 2, 174/52 R, 77 R

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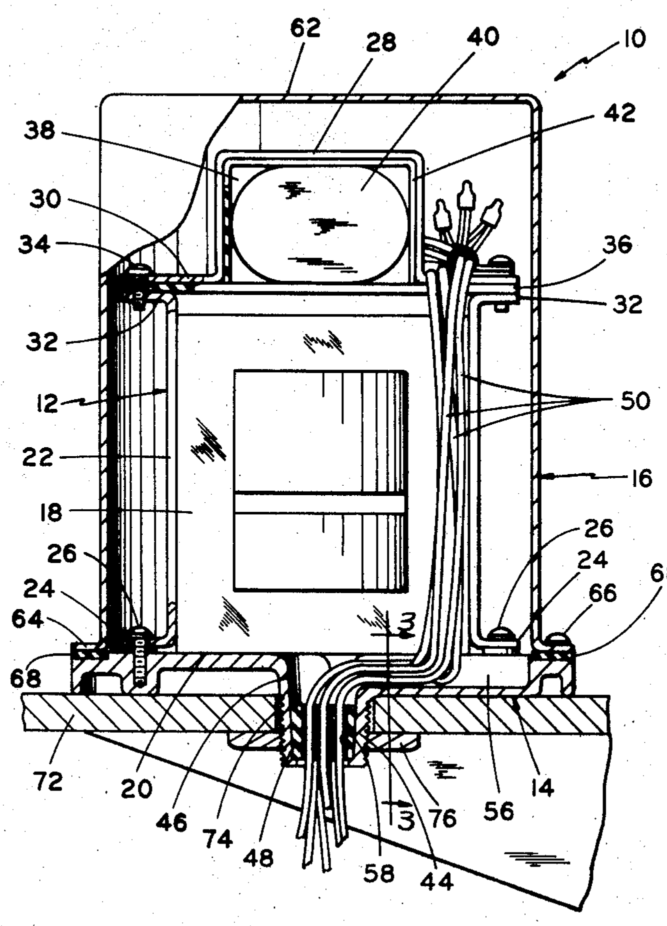
Primary Examiner—Laramie E. Askin
Assistant Examiner—Stanley J. Witkowski
Attorney—Silverman & Cass

[57] **ABSTRACT**

A ballast for gaseous discharge devices especially intended for connection to outdoor mercury lamps which is constructed to run cool and to be weatherproof. A transformer and condenser are mounted as a unit within a housing on an integral base of high heat conductivity metal and separated together from the canister or housing by airspace, and likewise separated from one another by airspace and a heat barrier. The ballast is unpotted and transfers heat to the housing wall by convection and radiation and to the base by condition, the transformer being in contact with the base. The housing is mounted on the base with an elastomer gasket between the housing and the base. The leads from the ballast are led to a nipple through wire-carrying channels integrally formed in the base. The nipple is also integral with the base and the leads emerge from the ballast by way of a frustoconical elastomer plug compressed within the nipple.

18 Claims, 4 Drawing Figures



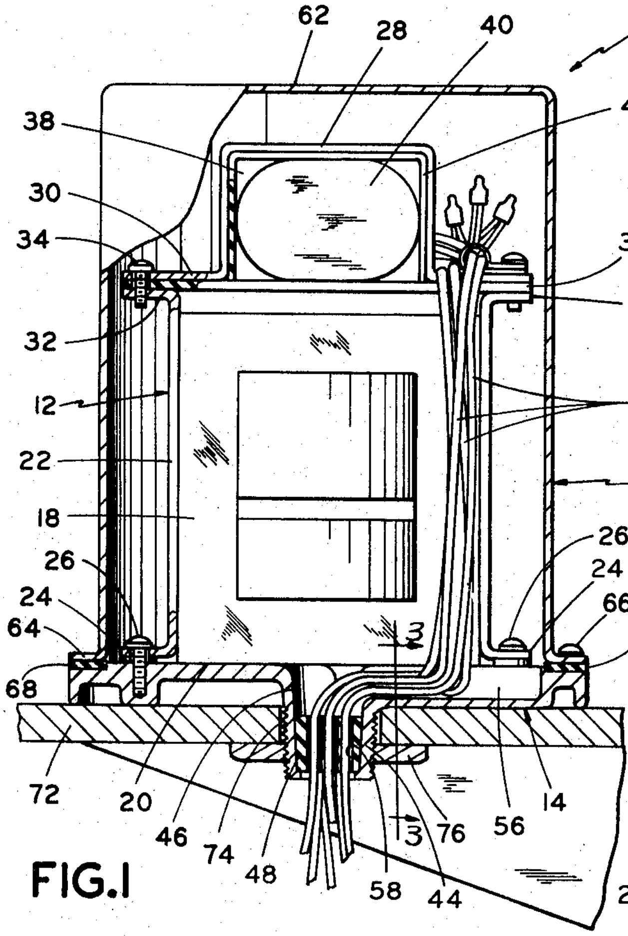


FIG.1

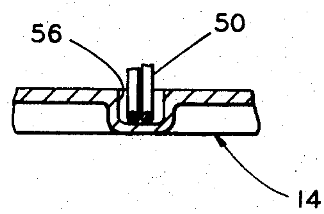


FIG.3

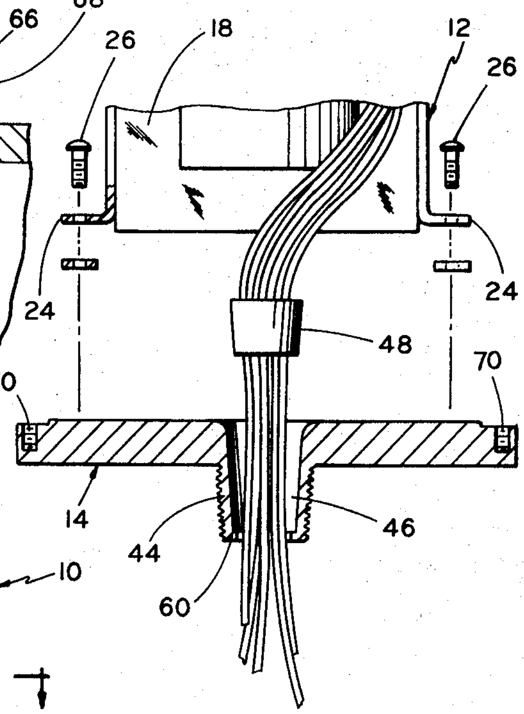


FIG.4

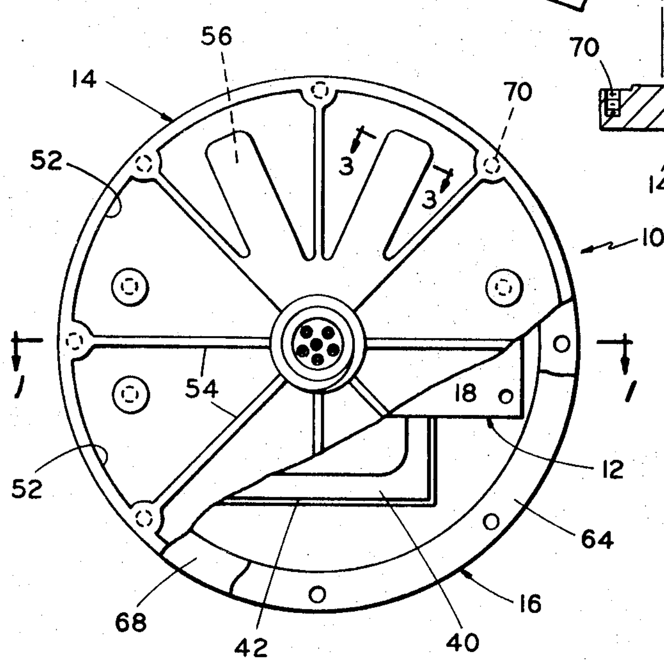


FIG.2

INVENTORS
ERNEST M. FREEGARD
SOL HASSON

BY Silverman + Cass
ATTORNEYS

WEATHERPROOF UNPOTTED BALLAST CONSTRUCTION

BACKGROUND OF THE INVENTION

The invention herein is concerned with the construction of a power supply such as a ballast for furnishing the ignition and operating voltages for mercury lamps or the like operated primarily outdoors.

Reliability is one of the most important factors in the construction of exterior ballasts of this type, since for the most part the lamps are mounted on high posts or secured to high walls or other structures, with the ballasts also mounted close to the lamps. Such ballasts are not readily accessible and hence replacement caused by failure due to weather or burnout is very expensive. It is thus most important that ballasts of this type run cool and that they be weatherproof. The invention achieves reliability in a weatherproof ballast that runs cool and does it in a very economical way.

The invention is not concerned with the type of mercury or sodium vapor lamp ballast in which there is a fixture within which the ballast is mounted. The ballast of the invention is expected to be exposed to the weather.

The ballasts of the prior art have, for the most part, been potted with some potting compound. This is an easy way to achieve a good degree of weatherproofing and to hold the parts of the ballast in place, but it has disadvantages. The technique of potting requires special capital equipment; requires the handling of potting compounds in liquid states which is messy and expensive; increases the weight of the ballast; may result in locations within the ballast which have increased temperatures and hence require materials which are expensive in the construction of the ballast; does not permit as ready transfer of heat to the canister of the ballast; prevents ready inspection of the interior of the ballast; gives rise to possible damages through high liquidity of the potting compound upon failure of the ballast.

Underwriters' Laboratories specify that the outside of the housing of a ballast of this type for mercury lamps and the like have a temperature not exceeding 90° Celsius. Because of the construction of the ballast to be described, it is possible to achieve the outside temperature of the case specified by using so-called Class H materials, that is, having an average copper temperature not exceeding 160° Celsius and a hot spot temperature not exceeding 180° Celsius. This permits using more economical designs than in the case of potted ballasts since the quantity of material is decreased and the interior of the ballast can be much hotter than the potted ballasts without increasing the exterior temperature beyond that specified by the Underwriters' Laboratories.

The ballast of the invention permits heat from the heat-producing component of the ballast to be radiated to the wall of the canister from which it is radiated to the atmosphere. Additionally, heat from the heat-producing component is transferred to a heat sink as described. The housing, in this invention, is made from deep-drawn or spun aluminum since it serves no supporting function as in the case of the usual potted ballast. Accordingly, it need not be galvanized as in the case of the usual steel canister, but can readily be anodized black for efficient radiation.

Other advantages are achieved with aspects of the construction of the ballast which will be detailed in the specification which follows. In this specification, a ballast for use with mercury lamps is described using a condenser and transformer. It should be kept in mind that the advantages of the invention apply to many other types of outdoor power supplies including those which use a reactor alone or with one or more condensers, and which use a transformer alone or with one or more condensers. Likewise, the invention may be used in the case of incandescent lamps requiring transformers for providing operating voltages. No limitations are to be inferred from the specific reference to a ballast for mercury lamps using a high leakage reactance transformer and a condenser.

SUMMARY OF THE INVENTION

The ballast of the invention comprises an integral base of high heat-conductive metal with an integral depending nipple by means of which the ballast may be mounted to a securing bracket. Mounted on top of the base in heat-conductive relationship therewith is the transformer portion of the ballast which is the principal heat-producing component so that heat tends to be transmitted to the base by conduction, the base serving as a heat sink in this regard. The condenser portion of the ballast is spaced from the transformer and there is a heat barrier of some insulating material between the transformer and condenser so that the minimum of heat will be transferred to the condenser from the transformer. The condenser and transformer are connected mechanically as a unit and, but for the engagement of the transformer with the base, which is at the bottom of the unit, the remainder of the unit is spaced from the canister. The canister is a cylindrical housing which encloses the condenser and transformer unit and is secured to the top of the base by suitable fastening means with an intervening gasket of suitable material. The electrical leads from the interior of the ballast are led through channels integrally formed in the upper surface of the ballast and through a plug which is compressed into the nipple, to the exterior of the ballast. The compression of the plug within the nipple constricts the openings in the plug around the leads passing through the plug thereby providing a weatherproof connection and also providing a high degree of strain-relief.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a sectional view of a ballast constructed according to the invention taken generally along the line 1—1 of FIG. 2 and in the indicated direction with portions being broken away and other portions being shown in elevation;

FIG. 2 is a bottom plan view of the ballast with portions shown broken away, the ballast in this case being shown free of the bracket to which the same is secured as in FIG. 1;

FIG. 3 is a fragmentary sectional detail taken along the line 3—3 of FIG. 1 and in the indicated direction; and

FIG. 4 is a fragmentary exploded sectional view showing the manner in which the lead wires are secured in the plug during the assembly of the ballast.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The reference character **10** designates generally the ballast of the invention, said ballast comprising an inner unit **12**, a base **14** and an outer housing in the form of a cylindrical canister **16** mounted on the base.

As understood, a ballast is a device which provides the igniting voltage for gaseous discharge devices and after ignition, provides the operating voltage for such devices. As such, it transfers power for maintaining the discharge devices in operation. The usual ballast includes at least a transformer and a condenser in circuit with the gaseous discharge device or devices, but it may have a reactor alone or with condenser means, or it may have a transformer alone. The voltages for ignition of gaseous discharge devices such as for example the mercury vapor lamps for which the ballast of this specification is especially intended are substantially higher than the operating voltages which are required to maintain the lamps ignited. When the mercury vapor within a lamp is ionized, the impedance of the lamp is that of the arc between the interior electrodes thereof and this is quite low. Accordingly, it is necessary to stabilize the arc by introducing a substantial reactance in the lamp circuit and this is accomplished in the modern ballast either by means of a condenser or the high leakage reactance built into the transformer of the ballast. The condenser is used for various purposes, including power factor correction. The principal heat-producing component of a ballast is the transformer since its copper losses and eddy currents in the laminations produce the principal heat. Little or no heat is developed in an efficient condenser such as, for example, those oil-filled condensers normally used in ballasts of this type. A condenser will have better operating characteristics and longer life if kept insulated from the heat of the transformer unit, and this is achieved in the invention as will be described in such power supplies as use condensers.

The transformer of the ballast **10** is shown at **18** with its bottom surface in intimate contact with the upper surface of the base **14** as shown at **20**, there normally being a conductive cement or compound of some kind applied here to transfer heat from the transformer **18** to the base **14**. The laminations and windings of the transformer are held in assembly by any suitable means such as clamps, welding, adhesive and the like and the transformer itself is impregnated in varnish and preferably painted black so that it will radiate efficiently.

In the present case, there is a framework **22** having flanges **24** at the bottom end thereof by means of which the transformer **18** and the entire unit **12** are connected firmly with the base **14** through the use of suitable fasteners **26**. The upper part of the framework **22** comprises a channellike yoke **28** having angled legs **30** which are held to the upper flanges **32** by means of the fasteners **34**. There is a relatively large member **36** of fiber of the type normally used in the construction of electrical components sandwiched between the legs **30** and the flanges **32**, the member **36** extending fully over the upper end of the transformer **18** and spaced above the same. The member **36** comprises a heat barrier and will be referred to hereinafter as such. Instead of fiber, the member can be made of any heat-resisting and heat-insulating material having sufficient strength to serve in the manner described.

The bridging heat barrier **36** closes the bottom of the yoke **28** to provide a boxlike space **38** within which the condenser **40** of the ballast **10** is disposed. The frame **22** and the yoke **28** are normally made of some robust metal such as sheet steel so that the unit **22** is sturdy and does not chatter or vibrate. The condenser **40** is wrapped in a layer **42** of so-called fish paper or some other insulating sheet material to keep it insulated from the yoke **28**, but it lies on top of the heat barrier **36** and preferably is tightly wedged between the yoke **28** and the heat barrier **36**.

From the above description, it may be observed that the heat barrier **36** not only helps to support the condenser **40**, but it also insulates it from the heat generated by the transformer **18**. In this way, the oil in the condenser **40** is not unduly heated thereby preventing deterioration thereof. This feature of the construction of the ballast **10** promotes long life of the condenser.

The base **14** is preferably in the form of a casting of aluminum having a central integral threaded hollow nipple **44** with its interior bore **46** occupied by a plug **48**. The electrical leads **50** connect the electrical components of the ballast with the lamps (not shown) and the external source of power (not shown). They must pass from the interior of the ballast to the exterior thereof, and the plug **48** carries these leads in weatherproof disposition to the exterior of the ballast. The base **14** may be lightened by having segment-shaped recesses such as shown at **52** formed in the bottom surface thereof, these recesses being separated by strengthening ribs **54**. One or more wire-carrying grooves **56** may be cast into the upper surface of the base **14**, these grooves enable the wires **50** to be laid under the transformer end and conducted to the bore **46**.

Inviting attention now to FIG. 4, the plug **48** is shown to be of frustoconical configuration, with its taper decreasing toward the end first inserted into bore **46**. It has the same number of passageways **58** as there are leads **50** passing to the exterior of the ballast **10**, and during assembly these leads or wires **50** are threaded through the passageways **58** after which the plug **48** is forced into the bore **46**. Preferably, a shoulder **60** formed on the interior of the end of the nipple **44** limits the amount of axial movement of the plug **48** during this assembly procedure. This action constricts the passageways **58** and, as a result, the leads **50** are tightly engaged within the plug **48**. The leads are usually in the form of coated wire, the coating being a smooth synthetic plastic or the like so that there is a very close clamping action. The plug **48** itself is made of some elastomer such as any of the synthetic rubbers or polymers which preserve their elasticity over long periods of time. Some success has been had with a polymer known as ethylene-propylene-terpolymer. The unit **12** is secured in place by the fasteners **26** after the plug **48** has been pushed home.

The canister **16** is an aluminum cylinder with a closed end **62** and its bottom end open and formed on its bottom edge with an annular flange **64**. Fasteners such as screws **66** pass through circumferentially spaced perforations in the flange **64** and through a narrow annular gasket **68** into suitable aligned screw-threaded sockets **70** formed in the base **14**. Preferably, the gasket **68** is formed of an elastomer such as any of the synthetic rubbers available, and when the screws **66** are tightened, the connection is waterproof. Neoprene has been used successfully. The canister **16** is deep-drawn or spun from sheet aluminum and is anodized black to provide for good radiation of the heat which the canister wall in turn receives by radiation from the transformer **18**.

The ballast **10** is adapted to be mounted onto a bracket **72** such as that disclosed in a copending application, Ser. No. 64,470, filed Aug. 17, 1970 by one of the applicants herein. Any other suitable bracket can be utilized, however, so long as it provides a passageway **74** within which the nipple **44** may be received and to which the ballast **10** may be secured by a nut **76** engaged over the end of the nipple **44** which protrudes from the bottom of the upper plate of the bracket **72**. The ballast **10** normally will be sold with the nut **76**.

It is pointed out that the wedging engagement of the plug **48** with the bore **46** of the nipple **44** serves several purposes. It evenly spaces the leads **50** as they emerge from the ballast **10**; it tightly engages these leads and thereby renders the junction of the leads **50** with the plug **48** waterproof while tightly engaging the plug within the only opening to the interior of the ballast also in waterproof condition; and it takes up any strain to which the leads **50** are subjected while the ballast **10** is being handled.

Another important feature of the invention as described hereinabove is the mounting of the interior unit **12** upon the base **14** spaced from the interior of the canister wall so that there is no contact with the canister. Also, the canister **16** need not have the strength for supporting the components. The outer surface is in contact with the atmosphere and efficiently radiates the heat from its black surface. The canister need not be made of steel which requires expensive galvanizing prior to painting.

In order to give some understanding of the actual physical nature of the ballast of the invention, an example of the same will be described. Insofar as size is concerned, the diameter of the canister **16** of a typical ballast was about six and one-half inches, and its length was eight inches. Other dimensions may be scaled from the drawing. This ballast was used for connection to one 250W–H37 mercury vapor lamp energized either from a 120-volt or 240-volt source (depending upon primary winding transformer connections) at 60 Hertz.

As previously indicated, the features of the invention are also applicable to other types of power supplies for gaseous discharge as well as incandescent lamps.

Variations are capable of being made to the details of the invention without departing from the spirit or scope thereof as defined in the appended claims.

What it is desired to secure by Letters Patent of the United States is:

1. A power supply apparatus for lamps to be used outdoors which comprises:

A. a power unit including at least a heat-producing component,

B. a unitary base of heat-conducting material, the power unit being mounted on the base with the heat-producing component in heat-transfer engagement with the base,

C. a one-piece canister of thin-walled heat-conducting material formed as a cylinder having one end closed and the other end open,

D. the open end of the canister being engaged upon the said base in a weatherproof joint and enclosing the power unit,
E. an integral, hollow, exterior nipple formed on the base and adapted to be engaged through an opening formed in a mounting bracket adapted to support the apparatus, and
F. the power unit having a plurality of electrical leads and the leads extending from the interior of the apparatus to the exterior thereof by way of the hollow of the nipple and being disposed therein in waterproof association therewith.

2. The power supply apparatus as claimed in claim **1** in which there is an air space within the power supply apparatus between the power unit and the interior of the canister wall.

3. The power supply apparatus as claimed in claim **1** in which there is an elastomeric plug compressed in the hollow of the nipple and the electrical leads pass through passageways formed in said plug and are tightly engaged in said passageways.

4. The power supply apparatus as claimed in claim **3** in which the elastomeric plug is frustoconical and is wedged into said hollow from the interior of the power supply apparatus.

5. The power supply apparatus as claimed in claim **4** in which the hollow is tapered to receive the plug and has a shoulder at its end to limit the movement of the plug into the hollow.

6. The power supply apparatus as claimed in claim **1** in which the nipple is formed in the center of the base and the heat-producing component has one edge thereof engaged upon said base over said nipple and in which said base has channel means integrally formed therein to convey said leads from the interior of the power supply to the hollow of the nipple beneath said heat-producing component edge.

7. The power supply apparatus as claimed in claim **1** in which the base is circular and the open end of the canister includes an annular flange engaged to the upper surface of the base around the periphery thereof and in which there is an elastomeric gasket clamped between the flange and said base.

8. The power supply apparatus as claimed in claim **2** in which the power unit includes a condenser in addition to said heat-producing component, a framework providing spacing between the condenser and the heat-producing component and a heat barrier is provided between the condenser and heat-producing component in addition to said spacing.

9. The power supply apparatus as claimed in claim **8** in which said framework includes a channel-shaped yoke having its open end closed off by said barrier and forming a boxlike space, said condensers being frictionally engaged within said boxlike space.

10. The power supply apparatus as claimed in claim **8** in which the base is circular and the open end of the canister includes an annular flange engaged to the upper surface of the base around the periphery thereof and in which there is an elastomeric gasket clamped between the flange and said base.

11. The power supply apparatus as claimed in claim **1** in which the heat-producing component is a transformer.

12. The power supply apparatus as claimed in claim **8** in which said heat-producing component is a transformer.

13. In a weatherproof power supply apparatus construction which includes a base, a power unit mounted on the base and a canister also mounted on the base and enclosing the power unit, means for leading electrical leads from the interior of the apparatus to the exterior thereof, comprising: an integral externally protruding hollow nipple on said base, an elastomeric plug wedged into the bore of said nipple from the interior of the ballast, passageways formed in the plug and the leads being tightly engaged in said passageway by reason of said wedging engagement.

14. The structure as claimed in claim **13** in which the bore is tapered with the smaller diameter furthest from the interior of the ballast and the plug is frustoconical.

15. The structure as claimed in claim **14** in which the end of the nipple has an interior shoulder to limit the extent of movement of the plug therein while same is being wedged in place.

16. In a ballast construction which includes a condenser and a transformer and in which there is a framework holding the condenser and transformer assembled together as a unit, means for insulating the condenser from heat generated in the transformer comprising: the framework including a channel-shaped yoke opening toward the transformer, support members for connecting the yoke to the transformer, a pair of angled legs on the yoke attached to said support members and a heat barrier disposed between the angled legs and the support members and closing off the opening of the yoke to provide with the yoke a boxlike formation, and the condenser being disposed within the boxlike formation.

17. The structure as claimed in claim **16** in which the heat barrier comprises a sheet member of heat-resistant insulating material.

18. The structure as claimed in claim **16** in which the heat barrier is fiber.

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