Oct. 11, 1960 A. R. DAVIS 2,956,249

PEAKING BALLAST

Filed March 9, 1956

Fig. 1.

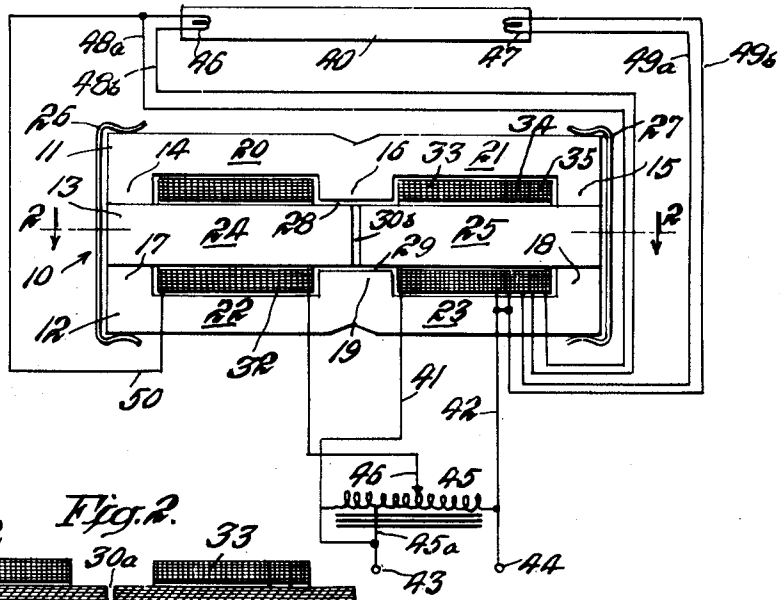


Fig. 2.

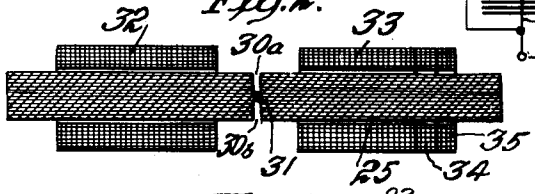


Fig. 3.

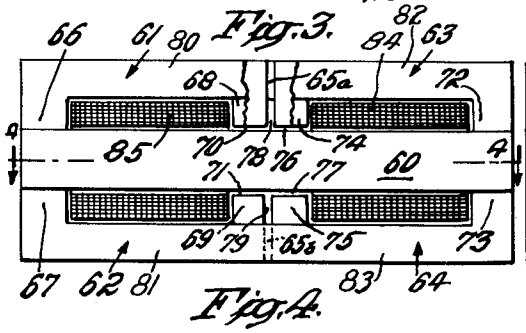


Fig. 4.

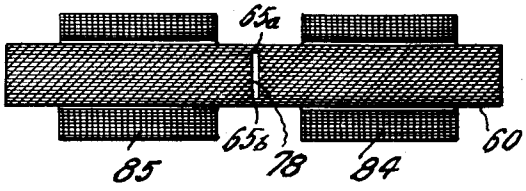


Fig. 5.

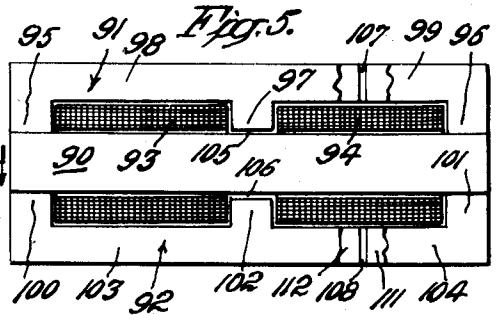
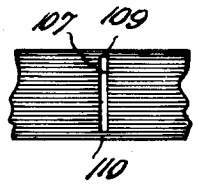


Fig. 6.



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PEAKING BALLAST

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4 Claims. (Cl. 336—165)

This invention relates to ballasts for dimming fluorescent lamps.

An object of the invention is to provide ballast means that will ignite a fluorescent lamp over a range of intensities of illuminations.

Another object of the invention is to provide an inductive means to vary the intensity of illumination of a fluorescent lamp over a wide range.

Another object of the invention is to provide a ballast for fluorescent type lamps that produces a sharp voltage pulse for igniting the lamp over a wide range of intensities of illumination.

A further object of the invention is to provide an inductive current limiting means that will ignite a fluorescent lamp at very low intensities of illumination with low R.M.S. voltages.

Other and further objects of the invention will be apparent from the following description taken in connection with the drawings in which:

Fig. 1 illustrates one embodiment of the invention with the associated circuit;

Fig. 2 is a sectional view of the ballast taken along lines 2—2 of Fig. 1;

Fig. 3 is another embodiment of the invention;

Fig. 4 is a sectional view taken along lines 4—4 of Fig. 3;

Fig. 5 illustrates another embodiment of the invention; and

Fig. 6 illustrates a top fragmentary view of a portion of the reactor core.

Referring to Fig. 1, there is shown a ballast **10** comprising a laminated ferromagnetic core comprising stacked laminations forming E-shaped core portions **11** and **12** and a center portion **13**. The portion **11** has end legs **14** and **15** and an intermediate leg **16**. The portion **12** has end legs **17** and **18** and an intermediate leg **19**. The end leg **14** and intermediate leg **16** are connected by side leg **20**, and end leg **15** and intermediate leg **16** are connected by side leg **21**. The end leg **17** and intermediate leg **19** are connected by side leg **22**, and end leg **18** and intermediate leg **19** by side leg **23**. The center portion **13** has laminated sections **24** and **25**. Section **24** extends between end legs **14**, **17** and intermediate legs **16**, **19** and section **25** between end legs **15**, **18** and intermediate legs **16** and **19**.

Clamping means **26**, **27** are provided at the ends of the ballast to securely hold the E-shaped portions and center portion together and securely hold the end legs **14**, **15**, **16**, **17** in magnetic contact with the center portion. The intermediate legs **16**, **19** are spaced to form air gaps **28** and **29** between the intermediate leg and the center portion.

The sections **24** and **25** are spaced to form air gaps **30***a*, **30***b* bridged by a lamination **31** or thin piece of core material. The gaps **30***a*, **30***b* are positioned intermediate to the legs **16** and **19** to provide flux paths between section **24** and intermediate legs **16** and **19** and section **25** and the intermediate legs.

The end and intermediate legs space the side legs from the center portion to form spaces for windings. The reactor or ballast winding **32** is positioned around the section **24** and transformer or main winding **33**, and filament windings **34**, **35** are positioned around section **25**. The section 24, end legs **14**, **17**, side legs **20**, **22** and intermediate legs **16**, **19** form parallel magnetic paths for the flux created by current through the reactor winding. Section **25**, end legs **15**, **18**, side legs **21**, **23** and intermediate legs **16**, **19** form parallel flux paths for the main winding and filament windings. The reactor flux path and main flux path have the air gaps **28**, **29** therein to increase the reluctance of the paths. Flux paths for both the reactor winding and main winding are provided by the center portion and the end legs **14**, **17**, side legs **20**, **21**, **22**, **23** and end legs **15**, **18**. The flux from the main winding passes through the lamination **31**, section **24**, legs **14**, **17**, side legs **20**, **22**, **21**, **23**, and end legs **15**, **18** to the section **25**. The air gaps **28**, **29** present a high reluctance to the initial flux of the main winding and the lamination **31** presents a low reluctance path. Since the amount of steel in the lamination **31** is small, the lamination saturates on a low amount of flux. The lamination then presents a high reluctance to the flux of the main winding and the flux then passes through the gaps **28**, **29** and the side legs **21**, **23**. Flux from the main winding also passes through the gaps **30***a*, **30***b*, center portion **24** and legs **14**, **17**, side legs **20**, **22** to the side legs **21**, **23**. The amount of flux depends on the reluctance of the path through the gaps **30***a*, **30***b* and through the gaps **28**, **29**. The flux of the reactor winding passes through the gaps **28**, **29** and side legs **20**, **22**. While the flux is increasing or decreasing through the lamination at each end of the flux cycle of the main winding, a high voltage is produced in the reactor winding. On saturation of the lamination **31**, the flux change ceases and the high voltage stops quickly to provide a sharp narrow peaking voltage. The gaps **30***a*, **30***b* preferably provide a high reluctance to the flux passing through the section **24** created by winding **32**. The flux path through the gaps **28**, **29** is lower than the flux path through the gaps **30***a*, **30***b*. The gaps **28**, **29** and the gaps **30***a*, **30***b* may have a reluctance relationship so that a portion of the flux from the main winding passes through gaps **30***a*, **30***b* to induce voltage in the reactor winding. This voltage is additive to the variable input voltage to provide the necessary illuminating voltage. The relation of the number of windings in the main winding **33** and reactor winding **32**, and the rate of change of flux threaded through the lamination **31** creates a voltage sufficient to ignite the tube.

The ballast **10** may be connected to the lamp **40** in several different ways. The main winding **33** may be connected by lines **41** and **42** across the input terminals **43**, **44**. An alternating voltage may be supplied to the terminals **43**, **44**. This voltage may be of the order of 120 volts and have a frequency of 60 cycles per second corresponding to the usual domestic and commercial voltages. An autotransformer **45** is connected across the terminals **43**, **44** and has a variable contact **46**. The winding of the autotransformer is extended to provide a booster section **45***a* and increase the voltage range of the autotransformer to 145 volts. The induced voltage in the reactor winding may be 85 volts to provide the 230 volts for full illumination. However, the gaps **30***a*, **30***b* may have a reluctance that reduces this value. A booster winding may then be added to the main winding to provide the necessary illuminating voltage. The filament windings **34**, **35** are connected to the cathodes **46**, **47**, respectively, of the lamp **10** by leads **48***a*, **48***b* and **49***a*, **49***b*. The main winding **33** is connected to lead

49*b* and the reactor winding **32** is connected to lead 48*a* by line **50**. The other end of reactor winding **32** is connected to contact **46** so that the voltage applied to the reactor winding **32** and lamp **40** in series may be varied between 85 volts and 230 volts. Thus the intensity of illumination of the lamp may be varied over a range of 500 to 1.

In Figs. 3 and 4 another embodiment of the ballast is shown in which there is a center member **60** made of stacked steel laminations. On each side of the center member are members of stacked steel laminations **61**, **62**, **63**, **64**, each having side and end legs. The members **61**, **62** with the center member **60** form a reactor core and members **63**, **64** with center member **60** form a transformer. The cores are coupled by rectangular interleaved laminations **65***a*, **65***b*. The members **61**, **62**, **63**, **64** and laminations **65***a*, **65***b* on sides of the aforementioned members are secured together by suitable means (not shown) so that end legs **66**, **67** of members **61**, **62** are in contact with the center member **60** and the end legs **68**, **69** are spaced to form gaps **70**, **71**. The members **63**, **64** have end legs **72**, **73** in tight magnetic contact with the center member **60** and end legs **74**, **75** spaced to form gaps **76**, **77**. The members **61**, **63** and members **62**, **64** are each respectively spaced to form gaps **78**, **79**. The gaps **79**, **78** have a higher reluctance than gaps **76**, **77** so that the flux passing through side legs **80**, **81** and **82**, **83** will go through the end legs connected thereto. The laminations **65***a*, **65***b* form low reluctance paths with the center number **60** to carry the initial flux of the main winding **84** and couple it with the reactor winding **85**. The laminations **65***a*, **65***b* saturate on a low amount of flux and the remaining flux of the main winding passes through the path provided by the side legs **82**, **83** and end legs **72**, **73**, **74**, **75**. This latter flux path has a higher reluctance than the laminations **65***a*, **65***b* flux path due to the gaps **76**, **77**; however, it has a higher flux carrying capacity.

The reactor winding flux is carried by the side legs **80**, **81** and end legs **68**, **69**, **70**, **71**.

In Fig. 5 another embodiment of the invention is shown in which the magnetic flux paths of the reactor winding have a discontinuity to produce a change in flux characteristic. The ballast has a laminated center portion **90** and E-shaped portions **91**, **92** on opposite sides thereof to provide parallel magnetic paths for the fluxes of the main winding **93** and reactor winding **94**. The E-shaped portion **91** has legs **95** and **96** and an intermediate leg **97**. The end leg **95** and intermediate leg **97** are coupled by a side leg **98**, and the end leg **96** and intermediate leg **97** are coupled by a side leg **99**. The E-shaped member **92** has end legs **100** and **101** and an intermediate leg **102**. The end leg **100** and the intermediate leg **102** are connected by a side leg **103**, and a side leg **104**. The end legs **91**, **92**, side legs **98**, **103** and intermediate legs **97**, **102** form parallel flux paths for the reactor winding **94**. A flux path for the main winding and the reactor winding is provided through the center member **90** and legs **95**, **100**, side legs **98**, **103**, **99**, **104** and end legs **96**, **101**.

The E-shaped portions and the center portion are clamped together by suitable clamping means (not shown) to hold the end legs **95**, **100**, **96**, **101** in tight magnetic contact with the center portion **90**. The center legs **97**, **102** are slightly spaced from the center portion **90** to form air gaps **105**, **106**. In the flux paths for the reactor winding **94**, a discontinuity is provided such as the slits or air gaps **107**, **108** in the side legs **99**, **104**, respectively. On each end of the gap **107** are laminations **109**, **110**, and at each end of gap **108** are laminations **111**, **112**. The initial flux passing through the side legs **99**, **104** thread through the laminations **109**, **110**, **111** and **112**. These laminations provide a low reluctance for the initial flux provided by the main winding **93**. On saturation of these laminations, the flux path is determined by the reluctance of the air gaps **107**, **108**. Since these gaps are wider and have a higher reluctance than the gaps **105**, **106**, the main portion of the subsequent increase in flux of the main winding **93** passes through the legs **97**, **102**. Some of the flux passes through the gaps **107**, **108** and the center portion **90** to induce voltage in the reactor winding additive to the input voltage for providing the required illuminating voltage. Thus, initially there is a flux change through the reactor winding **94** creating a voltage therein. But on saturation of the laminations **109**, **110**, **111**, **112**, this flux change ceases and the flux passes through the gaps **105**, **106**. On passage of arc current through the winding **94**, the flux created by arc current must pass through the air gaps **107**, **108**. For this reason the saturation characteristics of the flux path through the side legs **99**, **104** will be different from the flux of the reactor cores of the embodiment shown in Figs. 1 through 4. The air gaps **107**, **108** are turned to reduce the rate of saturation of the reactor core. This characteristic is another desirable feature imparted to the ballast.

It is thus seen from the foregoing description that by inserting a discontinuity in the magnetic path cooling the main winding and reactor winding so that the rate of change of flux is abruptly altered during the flux cycle of the transformer winding and preferably during the initial stages, a peaking voltage may be induced in the reactor winding. This voltage should have maximum value in the order of 400 volts so that the lamp will be ignited at the low intensity of illumination.

The above-described ballast is compact in size and inexpensive to manufacture.

Various modifications and changes may be made without departing from the scope of the invention as set forth in the appended claims.

I claim:

1. A ballast comprising a reactor winding, a main winding, a laminated ferromagnetic core having a center member with said reactor winding and said main winding wound thereon, E-shaped core members on opposite sides of said center member with intermediate legs between said windings and end legs at each end of said windings and side legs interconnecting said end and intermediate legs to complete the magnetic path of the flux of said windings, said intermediate legs spaced from said center member to form gaps therebetween, said center member having a substantially reduced cross section to provide a flux path having an initial low reluctance and a subsequent high reluctance coupling said main winding and said reactor winding to create a sharp high voltage pulse in said reactor winding, said reduced cross section being positioned in relation to said intermediate legs so that the center member forms with the intermediate legs a flux high capacity path of a greater reluctance than the initial reluctance of the reduced cross section and a lower reluctance than the subsequent higher reluctance of the reduced cross section to pass the flux of the main winding so that it does not link with the reactor winding.

2. A ballast as set forth in claim 1 wherein a low permeability cross section is provided in said center member to form said substantially reduced cross section, said reduced and low permeability cross sections being positioned between the intermediate legs so that flux paths for the main winding and reactor winding are provided in the center member and the intermediate legs for bypassing said reduced cross section.

3. A ballast as set forth in claim 2 wherein the flux path of the center member through the reduced cross section and the low permeability section has a reluctance on saturation substantially higher than the flux paths bypassing the reduced cross section.

4. A ballast comprising a reactor winding, a main winding, a laminated ferromagnetic core having a center member with said reactor winding and said main winding wound thereon, E-shaped core members on opposite sides of said center member with intermediate legs be-

tween said windings and end legs at each end of said windings and side legs interconnecting said end and intermediate legs to complete the magnetic paths of the flux of said windings, said intermediate legs spaced from said center member to form first non-magnetic gaps therebetween, said center member having a substantially reduced cross section portion and a second non-magnetic gap adjacent to said reduced portion, said reduced portion providing a flux path having an initial low reluctance and a subsequent high reluctance coupling said main winding and said reactor winding to create an initial flux coupling said main winding and said reactor winding and saturating said reduced section portion, said reduced portion and said second gap positioned between the ends of said intermediate legs and said intermediate legs extending on both sides of said reduced portion to overlap said center member on each side thereof to provide flux paths of high capacity on each side of said reduced portion between said center member and said intermediate legs, said second gaps having a substantially higher reluctance than said first gaps so that on saturation of said reduced portion the fluxes of said reactor winding and said main winding pass through said first gap to produce a high voltage pulse in said reactor winding.

References Cited in the file of this patent

UNITED STATES PATENTS

2,432,343	Short	Dec. 9, 1947
2,578,395	Brooks	Dec. 11, 1951

FOREIGN PATENTS

114,200	Australia	Nov. 20, 1941