An integrated electronic fluorescent ballast fixture (1) includes an electronic ballast combined with a set of fluorescent lamp connectors (6) into an integral fixture. The fixture has at least one circuit board operative with up to four fluorescent lamps. The housing (3) has a mechanism defining a number of lamp connector location slots (7). Except for U-shaped lamps, at least one lamp connector is disposed in a location slot (7) about the housing and electronically connected to the circuit board (2) by a wired, poke-in connector (9). The housing accommodates projecting electronic ballast components attached to the circuit board (2). The transformers (19, 19a) and transistors (30) of the circuit board (2) may be thermally sinksed, carrying heat to the housing by thermal conduction. The housing (3) consists of two halves assembled together with snap-in action latches (13). The ballast fixture can be accommodated to a wide variety of light fixtures via its modularity.
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BALLAST FIXTURE FOR FLUORESCENT LIGHTING

Field of the Invention:

The present invention relates to fluorescent light fixtures and, more particularly, to a fluorescent lighting ballast that is integrated with one or more fluorescent lamp connectors into a single, readily configurable package that provides a significant cost reduction to luminaire manufacturers and reduced installation time for installers.

BACKGROUND OF THE INVENTION

The process of manufacturing luminaires for fluorescent lighting has been improved and refined to such a high degree that there are almost no opportunities left for further cost reductions.

The present invention features a means for combining an electronic ballast with one or more fluorescent lamp connectors to form a single, easy-to-assemble, relatively light weight integrated fixture. By transferring a relatively small amount of materials cost from a luminaire to the fixture, the luminaire manufacturer minimizes the additional wiring needed to wire a luminaire, eliminates the need for certain parts in the luminaire, and eliminates several manufacturing processes. Thus, the integrated electronic ballast fixture offers a significant overall cost reduction to the luminaire manufacturer. The reduced installation time also benefits those who replace or upgrade ballasts at locations remote from the luminaire manufacturer.

The integrated electronic ballast fixture is designed for high-speed, low-cost manufacturability. This is accomplished by minimizing the amount of manual labor needed. To reduce the design cycle time and minimize capital expense, the fixture was designed to be able to use
off-the-shelf lamp connectors. Electrical connections to the fixture (AC power input, connections to the other end of lamps, lamps, dimmers, etc.) may be implemented as wires and/or one or more connectors, such as of the poke-in or wire-trap varieties. Even though the fixture is typically longer than a standard ballast, it is relatively light-weight since no potting compound is used.

A basic tenet of luminaire manufacturers has been to not allow changes (and in particular increases) to certain luminaire dimensions, such as the overall length, width, and thickness, in order to maintain backward compatibility with existing luminaires. Because of this design constraint, it is extremely difficult to offer a single integrated ballast fixture that can accommodate all combinations of up to four linear or U-shaped lamps to meet all applications. However, a given integrated fixture design with specific lamp spacings can easily accommodate different quantities and types of lamps. Thus, the integrated fixture of this invention provides a certain degree of universality.

The integrated electronic ballast fixture of this invention is believed to be a major breakthrough for the lighting industry, not only as a cost reduction, but also for its increased reliability. The ballast operates at a lower temperature compared to a standard form-factor enclosure, because the power being lost (in the form of heat) in ballast components such as transformers, resistors, and semiconductors is dissipated over a greater area in a larger volume. Also, since more space is available, components operating at higher temperatures can be spaced further apart to reduce additional heatup. If one or more components, such as a transformer, runs at a temperature higher than desired, further thermal enhancement may be included to increase the operating life. Since heat is dealt with by other means, the fact that this fixture uses no potting compound greatly enhances
reliability. Differences of the thermal coefficient of expansion between conventional potting compounds and various electronic components in prior ballasts may cause premature cracking of solder joints, thereby rendering those ballasts inoperative.

The electronic ballast circuitry of the present invention may include components for additional features such as step-dimming, automatic lamp current correction, lumen maintenance, automatic ambient light sensing, and remote ballast control. Sensors for functions such as automatic ambient light sensing may be attached directly to the fixture or may be mounted remotely. Also, the inclusion of more than one ballast, as well as the use of other ballast technologies (e.g., magnetic ballasts), instead of electronic ballasts in the fixture, is well within the scope of this invention.

Discussion of Related Art:

In United States Patent No. 5,519,289, issued to Corbett et al, on January 12, 1993, for SECURING COMPONENT ARRANGEMENT, a housing for securing a power transistor is disclosed. The housing acts as a heat sink for the printed circuit of the power transistors, which are inserted into the board from above. Wiring connectors and other components are also located and disposed about the circuit board in preformed holes.

SUMMARY OF THE INVENTION

In accordance with the present invention, there is provided an integrated electronic fluorescent ballast fixture including an electronic ballast that has been combined with a set of fluorescent lamp connectors into an integral fixture. The fixture has at least one circuit board that is operative with, typically, up to four
fluorescent lamps. The housing of the fixture has a mechanism defining a number of lamp connector location slots. Except in the case of U-shaped lamps, at least one lamp connector is disposed in a location slot about the housing, and is electrically connected to the circuit board by a wired, poke-in connection. The housing of the fixture is shaped to accommodate projecting electronic ballast components attached to the circuit board. The transformers and transistors of the circuit board may be thermally sunk, so that their heat is carried to the housing by thermally conductive means. The housing consists of two halves that are assembled together with snap-in action latches, making the fixture quickly and easily fabricated. The ballast fixture can be accommodated to a wide variety of light fixtures via its modularity, affording a high degree of universality.

It is an object of this invention to provide an integrated electronic ballast fixture that is modularly compatible, and is electrically operative, with a wide variety of light fixture arrangements.

It is another object of the invention to provide an integrated electronic ballast that is operative with a variable number of fluorescent lamps and lamp fixture designs.

It is another object of the invention to provide an integrated electronic ballast that may incorporate additional features such as step-dimming, automatic lamp current correction, lumen maintenance, and automatic ambient light sensing.

BRIEF DESCRIPTION OF THE DRAWINGS

A complete understanding of the present invention may be obtained by reference to the accompanying drawings, when
considered in conjunction with the subsequent detailed description, in which:

FIGURE 1 illustrates a perspective view of the integrated electronic ballast fixture of this invention;

FIGURE 2 depicts a perspective, exploded view of the integrated electronic ballast fixture shown in FIGURE 1;

FIGURE 3 shows a perspective view of the upper portion of the housing of the integrated electronic ballast fixture depicted in FIGURE 1;

FIGURE 4 illustrates a perspective view of the lower, mating portion of the housing of the integrated electronic ballast fixture depicted in FIGURE 1;

FIGURE 5 depicts a perspective view of the two portions of the housing illustrated in FIGURES 3 and 4, when joined together;

FIGURE 6a illustrates a side view of the heat sink and transformer assembly of the ballast circuit of the integrated electronic ballast fixture shown in FIGURE 1;

FIGURE 6b shows a perspective view of the heat sink strip used with the output transformer of the ballast circuit of the integrated electronic ballast fixture depicted in FIGURE 1;

FIGURE 6c depicts a perspective view of the heat sink strip used with the boost transformer of the ballast circuit of the integrated electronic ballast fixture illustrated in FIGURE 1;

FIGURE 6d illustrates a perspective view of a thermal heat sink clip used for the transistors of the electronic ballast circuit of the integrated electronic ballast
fixture shown in FIGURE 2;

FIGURE 6e shows a side view of the thermal heat sink clip as applied to the transistors of the circuit board of the integrated electronic ballast fixture illustrated in FIGURE 2; and

FIGURE 6f is a cross sectional view of a boost transformer and associated heat sink.

For purposes of clarity and brevity, like elements and components of this invention will bear the same designation or number throughout the figures.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Generally speaking, the invention features an electronic ballast that has been integrated into a single package with one or more lamp connectors to form a new fluorescent light fixture. The electronic ballast circuitry may include additional components for advanced features such as step-dimming, automatic lamp current correction, lumen maintenance, automatic ambient light sensing, and remote ballast control. The ballast and connectors are combined in a simple, relatively lightweight package that minimizes the additional wiring needed to wire a luminaire, eliminates the need for certain parts in the luminaire, and eliminates several manufacturing processes. Thus, the integrated electronic ballast fixture provides a significant cost reduction to luminaire manufacturers and reduced installation time for installers.

Now referring to FIGURES 1 and 2, the integrated electronic ballast fixture 1 of this invention is illustrated in a perspective assembled view and a perspective exploded view, respectively. The electronic ballast fixture 1 consists of a circuit board 2 with
circuitry and components for providing power for up to four fluorescent lamps.

A metal or plastic case 3 houses the internal components. The case or housing 3 consists of an upper, housing cover 4 and a lower, mating base 5. The circuit board 2 is disposed inside the housing 3. A plurality of lamp connectors 6 is positioned upon the upper housing cover 4 of the electronic ballast fixture 1, in various spacings and configurations. The configurational design defines the quantity of lamps that can be accommodated by the fixture. By varying the number of lamp connector location slots 7 disposed in the upper housing 4 (FIGURE 2), and their location, a great number of different lighting fixture manufacturers' luminaires can be accommodated. The location slots 7 are shown in more detail, and are further explained hereinbelow, with reference to FIGURE 3.

This adaptability to different manufactured luminaires and luminaire standards is made possible by the fact that the lamp connectors attach to the circuit board 2 by flexible wire means 8 instead of being soldered directly on the circuit board. This allows the fixture to be operable with one, two, three or four lamps at various spacings befitting the number of lamps. This is extremely important, because it reduces the board part numbers required to support a large number of products. This reduces the cost of manufacture. By positioning standard lamp connectors 6 to the upper case cover 4 instead of soldering them permanently to the circuit board 2, a great deal of flexibility and modularity is achieved by the inventive fixture. Reliability is greatly enhanced, since the forces exerted by the insertion or removal of lamps are isolated from the solder joints on the circuit board 2.

The standard lamp connectors 6 are each connected to the circuit board 2 by an insulated wire 8. The wires 8
are soldered or mechanically connected to the circuit board 2. During assembly of the fixture 1, a stripped portion 8a of the insulated wires 8 is inserted into a poke-in connector 9 at the base of each respective lamp connector 6.

Referring to FIGURE 4, the base portion 5 of the housing 3 is shown as having a plurality of integral board stand-offs and retention tabs 10. These integral stand-offs and tabs 10 are positioned on both sides of the base portion 5. The stand-off portion of the integral stand-off and tab 10 acts as a spacer for keeping the circuit board 2 a predetermined distance from the bottom of the base 5. It also holds the circuit board 2 firmly in place. Two board location tabs 11, are respectively punched out of the base 5 at the ends thereof, and are used to position the circuit board 2 laterally within the housing 3.

Referring to FIGURE 3, the components of the circuit board 2 are designed and positioned or located upon the circuit board 2 so as to allow the taller components to nest under the trapezoidal sections 4a of the upper housing cover 4. A grounding clip 12 (FIGURE 2), connected to a wire soldered into the circuit board 2, attaches to a tab 12a located in the side of the base portion 5 to provide a safe ground connection. The upper cover 4 of the housing 3 shows the location slots 7 of FIGURE 1 in more detail. The location slots 7 have two adjacent slot portions 7a and 7b. Each has a retention feature, which locates and holds each of the respective lamp connectors 6 firmly in place. The number of slots 7 and their location can be modified in the cover to accommodate various lamp quantities and spacings without affecting the circuit board 2.

The angular walls 4b of the trapezoidal section 4a have an approximate 30° angle with the base, and are incorporated in the upper cover 4 to provide effective
reflective surfaces for light reflectance and distribution. Further enhancement of light reflectivity may be achieved by crowning sections 4a. These angled surfaces 4b also allow for easy insertion and removal of the fluorescent lamps, which may require manipulation into the lighting fixtures in a manner inconsistent with a straight plug-in action. The fact that a typical lamp is approximately forty eight inches long requires that the lighting fixture be almost the same length. Therefore, the lamps are plugged in at an angle, which results in the aforementioned manipulation.

Retention latches 13 are punched out of, and are positioned around, the periphery of the base portion 5 of housing 3, as best observed with reference to FIGURES 2 and 3. These latches 13 mate with, and are captured by, the slots 14 disposed about the periphery of the upper cover portion 4 (best observed with reference to FIGURES 2 and 5). The slot locations 14 mate with the latch locations 13, as observed. This latching system provides for easy assembly of the fixture 1, and provides a positive retaining force between the two cover sections 4 and 5, respectively.

Two spaced-apart tabs 15 are each respectively disposed at mating locations in both the upper and lower portions 4 and 5, respectively, of the housing 3. When mated, as when the two housing portions 4 and 5 are assembled together, these tabs 15 form two mounting tabs for the fixture 1. These mated tabs 15 are positioned at the front lower surface of the fixture 1, as shown in FIGURE 1. They each contain a self-forming rivet hole 16 for screwing the fixture 1 to a particular luminaire. The tabs 15 are formed from a protrusion from both the cover portion 4 and the base portion 5, so that a secure ground connection is made during the rivet-connecting operation. This provides a safe ground connection for the entire fixture 1.
Referring to FIGURES 6a, 6b and 6f, a heat sink 18 is illustrated for the output transformer 19 of the electronic ballast circuit. The heat sink 17 for boost transformer 19a (FIGURE 6f) and heat sink 18 for the output transformer 19 may be respectively added to the assembly, as depicted in FIGURE 6a. These heat sinks 17 and 18 are made from a thin strip of aluminum, and are fashioned in such a way as to directly contact, and be slightly deformed by, both the ferrite cores of these transformers, and the inside surface of the cover 4. It has been found that half-hard aluminum performs well for this use. Heat sink 17 may be formed in a variety of shapes such as "V", "U", "S", or "Z", or a combination thereof. The reliability of the electronic ballast circuitry may be substantially increased by removing heat directly from these two transformers and transferring it directly to the thermally conductive cover 4. The metal strips of the respective heat sinks 17 and 18 are designed to form a compliant spring that provides a constant and direct thermal path from the ferrite cores 19 of the transformers, to the metal cover 4. It should be noted that the use of a heat sink to transfer heat away from a transformer to a thermally conductive enclosure may be applied to transformers in other applications where reduced temperature and increased reliability are needed or desired.

A notch 20 (FIGURE 6b) in heat sink 17 and heat sink tabs 20a (FIGURE 6c) in heat sink 18, positively locates and positions these heat sinks to their respective transformers. The use of aluminum metal, while thermally conductive, causes no electrical or magnetic effect on the transformers that will interfere with their electrical performance.

Referring to FIGURE 6d, a transistor heat sink clip 21 is shown for use with the transistor 30 (FIGURE 6e) in the circuit board 2 of the fixture 1 (FIGURE 2). Three of these transistor heat sink clips 21 hold the three main
transistors firmly to the base walls to provide heat
sinking for increased reliability. The transistor clips 21
are made from stainless steel and have a positioning tab 22
located at the base of the clip 21. The tab 22 latches
into slots 23 disposed about the sides of the base
portion 5, as shown in FIGURES 4 and 5. This latching
system provides for easy installation and prevents the
clips 21 from becoming dislodged.

A photosensor 24 (FIGURE 5) may be positioned about
the case cover 4 to allow for automatic adjustment of the
lighting in the fixture 1 with that of the ambient room
light. Thus, the integrated ballast can adjust to the
proper amount of light required. For example, such
regulation is most useful during bright outside light
conditions. The photosensor 24 can dim or deactivate one or
more lamps during bright light conditions, thus resulting
in substantial energy savings.

A mylar insulator 25 (FIGURE 2) is positioned under
the circuit board 2 to prevent possible shorting from leads
protruding from the back of the board 2 to the base
section 5.

A strain relief 26 (FIGURES 2 and 5) is positioned at
the front of the ballast. Three wires 27 egress from this
strain relief 26. Two of the wires 27 are for input power
and the other one is for a common connection to the
opposite ends of the fluorescent lamps, to complete the
lamp circuit. A board mounted poke-in connector can also
be used for this purpose.

Some of the major advantages of the fixture 1 of this
invention are the ability of the circuitry to service a
number of lamps, and to conform to various lamp spacings.
This includes the ability to vary quantity of lamps from
one to four. The use of a standard, inexpensive lamp
connector 6 provides an easy means by which a lamp
connector can be replaced without dismantling the ballast. The fixture is easily assembled and provides a cost-reduced assembling into the overall light fixture for the lighting manufacturers, due to its elimination of wire, hardware and labor. As aforementioned, there is improved thermal performance resulting in higher reliability and longer life of the ballast. In addition, the housing is designed to enhance the reflection of light, thus improving the lighting efficiency of the lighting fixture.

Since other modifications and changes varied to fit particular operating requirements and environments will be apparent to those skilled in the art, the invention is not considered limited to the example chosen for purposes of disclosure, and covers all changes and modifications which do not constitute departures from the true spirit and scope of this invention.

Having thus described the invention, what is desired to be protected by Letters Patent is presented in the subsequently appended claims.

What is claimed is:
1. An integrated fluorescent ballast fixture comprising at least one ballast that has been combined with one or more lamp connectors into an integral light fixture, said light fixture comprising:

   at least one circuit board containing said ballast, said circuit board being operative with a range of fluorescent lamps;

   a housing supporting said circuit board and comprising means defining a number of lamp connector location apertures;

   at least one lamp connector disposed in a location aperture in said housing; and

   connection means for electrically connecting said at least one lamp connector to said circuit board.

2. The integrated electronic fluorescent ballast fixture in accordance with claim 1, wherein said connection means comprises a poke-in connector for receiving an electrical wire from said circuit board.

3. The integrated electronic fluorescent ballast fixture in accordance with claim 1, wherein said housing of the fixture is shaped to accommodate projecting electronic ballast components attached to the circuit board.

4. The integrated electronic fluorescent ballast fixture in accordance with claim 1, wherein said housing comprises at least one substantially trapezoidally-shaped unit for accommodating projecting electronic ballast components, and for providing light reflectance.
5. The integrated electronic fluorescent ballast fixture in accordance with claim 1, wherein said circuit board comprises transformers and transistors, and further wherein said transformers and transistors are thermally sunked so that their heat is carried to said housing.

6. The integrated electronic fluorescent ballast fixture in accordance with claim 5, wherein the thermally sunked transformers and transistors are thermally sunked by thermally conductive means disposed between respective transformers and transistors, and said housing.

7. The integrated electronic fluorescent ballast fixture in accordance with claim 1, wherein the housing comprises two halves that are snap-action assembled to each other.

8. The integrated electronic fluorescent ballast fixture in accordance with claim 7, wherein one of the two halves of the housing comprises male elements, and further wherein the other one of the two halves of the housing comprises female elements for accommodating said male elements, said male and female elements quickly snapping together for easily fabricating said housing.
9. An integrated electronic fluorescent ballast fixture comprising, in combination, a set of fluorescent lamp connectors electrically and mechanically connected to an electronic ballast to form an integral light fixture, said light fixture comprising:

   a circuit board containing said electronic fluorescent ballast having transistors and transformers, said circuit board accommodating, and being operative with, a range of fluorescent lamps;

   a bifurcated housing supporting said circuit board and comprising means defining a number of lamp connector location apertures; and

   at least one lamp connector disposed in a lamp connector location aperture of said housing, and being electrically connected to said circuit board by connection means.

10. The integrated electronic fluorescent ballast fixture in accordance with claim 9, wherein said lamp connector is electrically connected to said circuit board by means of a poke-in connector disposed therein, said poke-in connector receiving an electrical wire from said circuit board.

11. The integrated electronic fluorescent ballast fixture in accordance with claim 9, wherein said bifurcated housing is shaped to accommodate projecting electronic ballast components attached to the circuit board.

12. The integrated electronic fluorescent ballast fixture in accordance with claim 9, wherein said bifurcated housing comprises at least one substantially trapezoidally-shaped unit for accommodating projecting electronic ballast components, and for providing light reflectance.
13. The integrated electronic fluorescent ballast fixture in accordance with claim 9, wherein said transformers and transistors of said circuit board are thermally sinksed, such that their heat is carried to said bifurcated housing.

14. The integrated electronic fluorescent ballast fixture in accordance with claim 13, wherein the thermally sinksed transformers and transistors are thermally sinksed by thermally conductive means disposed between respective transformers and transistors, and said bifurcated housing.

15. The integrated electronic fluorescent ballast fixture in accordance with claim 9, wherein the bifurcated housing comprises two halves that are snap-action assembled to each other.

16. The integrated electronic fluorescent ballast fixture in accordance with claim 15, wherein one of the two halves of the housing comprises male elements, and further wherein the other one of the two halves of the housing comprises female elements for accommodating said male elements, said male and female elements quickly snapping together for easily fabricating said housing.
17. An integrated electronic fluorescent ballast fixture comprising, in combination, a set of fluorescent lamp connectors electrically and mechanically connected to an electronic ballast to form an integral light fixture, said light fixture comprising:

a circuit board containing said electronic fluorescent ballast having transistors and transformers, said circuit board accommodating, and being operative with, a range of fluorescent lamps;

a bifurcated housing supporting said circuit board within two housing sections, and further comprising connection means defining a number of lamp connector location slots disposed about said housing; and

at least one lamp connector disposed in a lamp connector location slot of said housing, and being electrically connected to said circuit board by connection means.

18. The integrated electronic fluorescent ballast fixture in accordance with claim 17, wherein said bifurcated housing comprises at least one substantially trapezoidally-shaped unit for accommodating projecting electronic ballast components, and for providing light reflectance.

19. The integrated electronic fluorescent ballast fixture in accordance with claim 17, wherein said transformers and transistors of said circuit board are thermally sunked, such that their heat is carried to said bifurcated housing.
20. The integrated electronic fluorescent ballast fixture in accordance with claim 19, wherein the thermally sunked transformers and transistors are thermally sunked by thermally conductive means disposed between respective transformers and transistors, and said bifurcated housing.

21. The integrated fluorescent ballast fixture in accordance with claim 1, wherein said ballast is of the electronic variety.

22. A conformable, thermally conductive member for placement between a heat-generating component and a heat sink, said conformable, thermally conductive member being formed from a creep-resistant material and having a cross-sectional shape that facilitates compression of said member between said heat-generating component and said heat sink.

23. The conformable, thermally conductive member as recited in claim 22, wherein said material is half-hard aluminum.

24. The conformable, thermally conductive member as recited in claim 22, wherein said cross-sectional shape is one from the group of circular, oval, "V", "U", "S", and "Z" shapes.

25. The conformable, thermally conductive member as recited in claim 22, wherein said cross-sectional shape is a combination of at least two from the group of circular, oval, "V", "U", "S", and "Z" shapes.

26. The conformable, thermally conductive member as recited in claim 22, wherein said heat-generating component is a transformer.

27. The conformable, thermally conductive member as recited in claim 22, wherein said heat-generating component is a transistor.
28. The conformable, thermally conductive member as recited in claim 22, wherein said heat-generating component is an electronic packaging structure.

29. The conformable, thermally conductive member as recited in claim 22, wherein said heat sink comprises a housing.

30. The conformable, thermally conductive member as recited in claim 22, further comprising locating means to positively position said conformable member relative to said heat-generating component.

31. The conformable, thermally conductive member as recited in claim 22, further comprising locating means to positively position said conformable member relative to said heat sink.
**INTERNATIONAL SEARCH REPORT**

**A. CLASSIFICATION OF SUBJECT MATTER**

<table>
<thead>
<tr>
<th>IPC(6)</th>
<th>US CL</th>
<th>According to International Patent Classification (IPC) or to both national classification and IPC</th>
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<tr>
<td>F21K 27/00</td>
<td>362/260, 218, 219, 221, 225; 439/235</td>
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</table>

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)


Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

NONE

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

USPTO APS search terms: heat sink, ballast, fluorescent, aluminum, transformer

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

<table>
<thead>
<tr>
<th>Category*</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>US 3,495,131 A (MELCHER) 10 February 1970, (10/02/70) see entire document.</td>
<td>1-31</td>
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<tr>
<td>A</td>
<td>US 3,572,428 A (MONACO) 23 March 1971, (23/03/71) see entire document.</td>
<td>1-31</td>
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<tr>
<td>X/Y</td>
<td>US 3,974,418 A (FRIDRICH) 10 August 1976, (10/08/76) see entire document.</td>
<td>22-25, 28-31/26, 27</td>
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<td>A</td>
<td>US 3,989,335 A (BELOKIN, JR.) 02 November 1976, (02/11/76) see entire document.</td>
<td>1-31</td>
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<tr>
<td>Y</td>
<td>US 4,344,106 A (WEST et al) 10 August 1982, (10/08/82) see entire document.</td>
<td>5, 6, 13, 14, 19, 20, 26, 27</td>
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</table>

Further documents are listed in the continuation of Box C. See patent family annex.

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<th><strong>P</strong></th>
</tr>
</thead>
</table>

*Special categories of cited documents:
**A** document defining the general state of the art which is not considered to be of particular relevance
**B** earlier document published on or after the international filing date
**L** document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another edition or other special reason (as specified)
**O** document referring to an oral disclosure, use, exhibition or other means
**P** document published prior to the international filing date but later than the priority date claimed

**T** document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

**X** document of particular relevance, the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

**Y** document of particular relevance, the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

**A** document member of the same patent family

**Date of the actual completion of the international search**

30 JULY 1998

**Date of mailing of the international search report**

9 AUG 1998

Name and mailing address of the ISA/US

Commissioner of Patents and Trademarks

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Authorized officer

SANDRA O'SHEA

Telephone No. (703) 305-4939

Form PCT/ISA/210 (second sheet)(July 1992)*
<table>
<thead>
<tr>
<th>Category</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim No.</th>
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<tbody>
<tr>
<td>X/Y, E</td>
<td>US 5,720,546 A (CORRELL, JR. et al) 24 February 1998, (24/02/98) see entire document.</td>
<td>1-4, 7, 8, 9-12, 15-18, 21/5, 6, 13, 14, 19, 20</td>
</tr>
<tr>
<td>A,E</td>
<td>US 5,751,117 A (ABBOTT) 12 May 1998, (12/05/98) see entire document.</td>
<td>1-31</td>
</tr>
</tbody>
</table>
### Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This international report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
   because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
   because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos.:
   because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

### Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

   Please See Extra Sheet.

1. ☑ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

**Remark on Protest**

☑ The additional search fees were accompanied by the applicant’s protest.

☐ No protest accompanied the payment of additional search fees.

Form PCT/ISA/210 (continuation of first sheet(1))(July 1992)
B. FIELDS SEARCHED
Minimum documentation searched
Classification System: U.S.

362/260, 218, 219, 221, 225, 362; 439/235, 56, 57, 58, 76.1, 226; 361/674, 683, 686, 687, 690, 692, 696, 697, 699,
700, 704, 709, 711, 712, 713, 714, 715, 716, 717, 718

BOX II. OBSERVATIONS WHERE UNITY OF INVENTION WAS LACKING
This ISA found multiple inventions as follows:

This application contains the following inventions or groups of inventions which are not so linked as to form a single
inventive concept under PCT Rule 13.1. In order for all inventions to be searched, the appropriate additional search
fees must be paid.

Group I, claim(s)1-21, drawn to an integrated electronic ballast fixture, classified in class 362, subclass 260.
Group II, claim(s) 22-31, drawn to conformable, thermally conductive member, classified in class 361, subclass 704.

The inventions listed as Groups I and II do not relate to a single inventive concept under PCT Rule 13.1 because, under
PCT Rule 13.2, they lack the same or corresponding special technical features for the following reasons: the structural
limitations of the integrated electronic fluorescent ballast fixture is completely different from the specifics of the
conformable, thermally conductive member.

During a telephone conversation with Mark Levy on 30 July 1998, the search of Group II was authorized by Mark
Levy. Mr. Levy provided that fees should be drawn from Deposit Account # 19-0077.