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5 **FLUORESCENT LAMP BALLAST COMBINED WITH ELECTRONIC STARTER
AND RESONANT CAPACITOR FOR REDUCING INPUT CURRENT**

10 The invention of the FLUORESCENT LAMP BALLAST COMBINED
WITH ELECTRONIC STARTER AND RESONANT CAPACITOR FOR
REDUCING INPUT CURRENT is a unique kind of fluorescent lamp gadget that
simplifies the system and solve all the problems in relation with the fluorescent
lighting system as well as maximizing the savings in electrical consumptions.

15 The invention constitute a primary coil which will control the input current,
connected directly to the powerline terminal, L_1 , a secondary coil connected in
series with the primary coil that will help in raising the inductances for the creation
of the high voltage across the capacitor, C_1 , a secondary circuit with the capacitor,
 C_1 , for the charging and discharging of current and a Quadrac for the switching
on and off during the charging and discharging of capacitor are connected in series
20 with the secondary coil, in between the primary coil and secondary coil is a
distribution line, DL_1 , connected to the filament, F_1 , the other end of the
secondary circuit is directly connected to the powerline terminal, L_2 , and the
distribution line, DL_2 , to the filament, F_2 , of the fluorescent lamp, a tertiary circuit
consist only of capacitor that will reduce the input current and saves electricity
25 is connected in parallel to the powerline terminals, L_1 and L_2 .

PROBLEMS ENCOUNTERED with the CONVENTIONAL FLUORESCENT
LAMP SYSTEM using ORDINARY BALLAST and CONVENTIONAL STARTER.

30 **1) DELAYED STARTING**

Using ordinary ballast with conventional starter has been the main source of
a hard-starting fluorescent lighting system. Inconveniences to the end-users have
always been a sorry-state for the people who were using fluorescent lighting

5 system. The culprit is the conventional starter. It is a mechanical type of electrical switch that is sensitive to heat induced by a neon gas. Upon sensing the heat, it will bend to close the circuit thereby preheating the two filaments of the fluorescent tube.

10 After closing the two contact points, heat is reduced inside the starter and instantaneously opened the two contact points. At this point of time a sudden opening of contact points induces a very high voltage at the ballast which will kick-off the starting current inside the fluorescent tube.

15 Actually, anything that moves (mechanical) will have an untimely mechanical defect (enhanced). Therefore the life-span of this starter can be very short.

20 In electrical point of view, contact points will also have a short life-span due to the constant devastation of contact point surfaces by electrical sparks.

All these short-comings can cause hard-starting situation of the fluorescent lighting system.

25 2) EARLY DUMPING OF FLUORESCENT TUBES INTO TRASH CANS.

Again the culprit is the conventional starter. Once the two contact points remains in contact for a long period of time intermittently, it will cause to melt the filaments and breaks open the continuity of the whole circuitry.

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Hence, the tube could not anymore be used to its full span of burning-hours indicated by its manufacturer.

3) COULD NOT START DURING LOW VOLTAGE FLUCTUATION

5 USUALLY OCCURRING IN THE PROVINCES.

The ballast can be the main reason why during low voltage fluctuations in rural areas, the fluorescent lighting system will just keep on flickering.

10 The minimum recorded voltage in the province is 160 volts AC. The least voltage that the fluorescent lamp can light up is 190 volts AC. Below this, the ballast cannot attain or induce the required voltage to start a fluorescent lamp.

15 SAFETY AND ECONOMIC DISREGARD ON THE PROPER USE OF CONVENTIONAL BALLAST AND STARTER BY THE END USERS.

There are two reasons why the end-users should use a power factor corrector gadget. But these were not explained well by the manufacturers of the ballast. The end-users on the other hand may not bother to use the component.
20 It may be due to additional cost or complexity in the installations or assembly of the fluorescent fixtures. Anyway as they presumed, it will still light up.

1) 50% SAVINGS IN ELECTRICITY BILL PER FLUORESCENT LAMP

25 A ballast consumes lots of electricity. It was found that a 20 watt fluorescent lamp with a 20 watt ballast (brand: DELTA) of a 220 volts AC line voltage, will have a current reading of 0.35 Amp.

30 Using a capacitor of $3.5\mu\text{F}$ across the input lines, the current reading becomes 0.16 Amp. Therefore, 50% savings per fixture of 20 watt fluorescent lamp can be attained without discriminating its luminance. The same is true with the other wattages of fluorescent lamps.

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2) SAFER TO USE

Heat induced in every electrical devices will depend on the current passing thru the resistance from the formula :

$$P_{\text{heat}} = I_{\text{(current)}}^2 \times R_{\text{(resistance)}}$$

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Every gadgets have its own resistance. It is obvious that a fluorescent lamp system without a capacitor across the input lines, will have a tendency of overheating and may cause fire.

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Using a capacitor across the input lines will double the safety factor of the fluorescent lamp system.

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THE INVENTION OF FLUORESCENT BALLAST WITH UNIQUE ELECTRONIC STARTER AND RESONANT CAPACITOR FOR REDUCING INPUT CURRENT IS THE STATE-OF-THE-ART SOLUTION OF THE PREVIOUSLY ENCOUNTERED PROBLEMS.

It is a system that incorporate the uniquely designed ballast with electronic starter and a capacitor to resonate with the ballast.

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The ballast is not anymore used as a high voltage inducer component but half of it is used to control the flow of current. The other half is connected in series with the capacitor as shown in fig. 2 to increase the starting voltage required to start a fluorescent lamp. The electronic starter uses impedances from which the voltage across the capacitance which is in series with an inductance will have an unusual high voltage effect.

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The capacitor is switched on and off using a quadrac (a semi-conductor switching device) for charging and discharging during starting situation. Once the fluorescent lamp has started, the semi-conductor switch (quadrac) will switched off

5 due to the voltage drop accross the fluorescent lamp.

THE PURPOSE AND ADVANTAGES OF THIS INVENTION CAN BE EXPLAINED
AS AGAINST THE CONVENTIONAL BALLAST AND STARTER.

10 1) The Fuorescent Lamp Ballast Combined with Electronic Starter
and Resonant Capacitor is a rapid start system.

Once a semi-conductor switch (Quadrac) is triggered on the charging of
current into the capacitor commenced. It will react with the inductances in series
15 and the result is the creation of a high voltage across the capacitor as well as across
the load itself which is the fluorescent lamp.

The creation of high voltage is instantaneous. Unlike the conventional starter
which will pass a series of stages before kicking-up an induced high voltage into
20 the fluorescent tube.

2) Extends the life of a fluorescent lamp.

Once a filament is cut-off or the two filaments are cut-off, the circuit
25 becomes incomplete and the fluorescent lamp should need replacement.

It is impossible to short-out the two terminals of each filament with the
conventional starter otherwise a ballast overheats in a short period of time and the
30 coils become grounded to the negative core and will render useless.

The invention of Fluorescent Lamp Ballast Combined with Electronic Starter
and Resonant Capacitor for Reducing Input Current can extend the life-span of
a fluorescent lamp to its maximum specified burning hours.

5 It doesn't need pre-heating of the filaments because the capacitor itself
across the load creates the required high voltage to kick-off electrons inside to
start the fluorescent lamp.

3) Very convenient and useful in the provinces

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Since the ballast is not anymore used as the source of high voltage in
starting the fluorescent lamp, variations of voltages with a minimum of 160 line
voltage cannot anymore hinder in starting the fluorescent lamp because the creation
of high-voltage across the capacitor is enough to start the fluorescent lamp.

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Additional inductances in series with the capacitor coming from the uniquely
designed ballast ensures the starting capability for the latest "TLD" fluorescent
tubes.

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THE FOLLOWING IS THE DETAILED DESCRIPTION WITH THE SCHEMATIC
DIAGRAM OF THE PRESENT INVENTION.

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Referring to the schematic diagram of Fig. 2 with reference to the
alphanumeric label which designates same parts, throughout the circuit, there is
shown a fluorescent lamp with filaments F_1 and F_2 connected at the distribution
lines DL_1 and DL_2 respectively from the primary circuit which consist of capacitor, C_1
serially connected with the semiconductor switch, quadrac, the other terminal of
capacitor C_1 , is connected to the second coil of the ballast, in between the coil₁
and coil₂ of the ballast is connected to the distribution line, DL_1 , the other terminal
30 MT_2 of quadrac is connected to the distribution line, DL_2 , the only trigerring
component of quadrac is a resistor, one terminal of which is connected to the
second terminal, MT_2 of quadrac and the distribution line, DL_2 .

5 The specially designed ballast is unique that consist of two coils, coil 1 and
coil 2. The two coils have different uses. Coil 1 is mainly for the control of current
passing thru the fluorescent lamp. But primarily for helping in creating the high
voltage across the capacitor C_1 . The second coil, coil 2, which is in series with the
first coil, coil 1, is for an additional inductances in series with the capacitor, C_1 , to
10 ensure that the required open-circuit-voltage across the fluorescent lamp is
attained.

 The ballast has three terminals, they are B_1 , B_2 and B_3 . The first terminal,
 B_1 , is directly connected to the powerline, L_1 , and the first terminal of capacitor,
15 C_2 , the second terminal of the ballast, B_2 , is directly connected to the first
distribution line DL_1 , the third terminal, B_3 , of the ballast is directly connected to the
first terminal of capacitor, C_1 .

 The secondary circuit which is solely composed of capacitor, C_2 , the
20 purpose of which is to reduce the input current by as much as half when in
resonance with the ballast terminal of capacitor, C_2 , designated as C_{2b} is connected
to the powerline terminal, L_2 , terminal of Quadrac, MT_2 , and the distribution line,
 DL_2 .

25 THE OPERATION OF THE WHOLE CIRCUITRY CAN BE FULLY APPRECIATED
AND UNDERSTOOD BY THE FOLLOWING EXPLANATION.

 Assuming, a switch is to be connected with the powerline terminal either L_1
or L_2 and the power is switched on. See Fig. 2.

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 The first half cycle which we will assume as negative, will pass thru the two
coils of the ballast, coil 1 and coil 2, from the powerline, L_1 , into the main capacitor,
 C_1 , charging the plate negatively while the opposite plate of the capacitor is charged
positively since the other powerline terminal, L_2 is positively going inside and into
the second terminal, MT_2 of Quadrac.

5 The lone resistance which is used in triggering the Quadrac will sense the
current flowing into it and instantaneously trigger the bidirectional component which
is incorporated inside the semiconductor switch, thereby switching on the Quadrac
and so does charging the plate of capacitor connected to the first terminal, MT₁, of
Quadrac positively.

10

At this instant, the distribution lines DL₁ and DL₂ connected into the
filaments, F₁ and F₂. Still have an open circuit while the capacitor and inductors are
building up their voltages to attain the required open-circuit-voltage required to start
the fluorescent lamp.

15

The next half cycle going into the system will be positive at the powerline
terminal, L₁ and negative at the powerline terminal, L₂.

20

This time the reaction between the inductances and the capacitor becomes
eminent due to the reversal flow of current thus creating a high voltage situation
across the distribution lines, DL₁ and DL₂.

25

Simultaneously, the fluorescent lamp will start due to the high voltage
kick-off of electrons inside the lamp. At the instant the fluorescent lamp has started,
it develops a run-away high current and this is because the resistance inside the
lamp reduces drastically thereby there will be a voltage drop situation across the
fluorescent lamp.

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This voltage drop situation decouples the connection of capacitor, C₁
through the Quadrac since the current thru the resistor could not anymore trigger the
bidirectional diode inside the Quadrac.

During this critical moment, the coil, coil 1, of the ballast will have its turn of
controlling the flow of the run-away current inside the fluorescent lamp.

5 Furthermore, another capacitor, C_2 , is incorporated in one system for safety
purposes and as well as savings much of electricity by reducing the current, without
degrading the fluorescent lamps illumination.

10 The capacitor, C_2 , as seen on Fig. 2 is connected across the powerlines, L_1
and L_2 . To explain how this capacitor reduces the current in the system;

During its operation, capacitor, C_1 , will no longer work with the system and
only capacitor, C_2 , is operating in parallel with the coil, coil 1, of the ballast which is
in series with the fluorescent lamp. See Fig. 1 for comparison.

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If we have to follow the complex formula of any electrical books by using
equations for parallel circuits, the result is stunningly different with the actual
measurements.

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As you can see in my own formula, instead of using equation for parallel
circuit, the equation for series circuit is amended and correctly applied. The prior
series formula has its reactive capacitance, X_C , deducted to the reactive inductance,
 X_L .

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While the true formula as can be proven by actual measurements, has its
reactive capacitance, X_C , added to the reactive inductance, X_L , and so the reactance
of this capacitor, C_2 , across the powerlines, L_1 and L_2 is virtually a series reactance
of the inductive reactance of the ballast and the load.

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This phenomenon can be explained with the theory of the "resonant effect"
between the capacitor and the inductor using the famous LENZ LAW.

LENZ LAW states that "In all cases of electromagnetic induction, the
induced voltages have a direction such that the currents which they produce

5 opposed the effect which produces them."

It is not anymore reasonable to discuss in detail how the resonant frequency reduces the current. Superficial understanding of the theory can be explained thru the birds-eye-view of the whole thing.

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Firstly, the coil opposes the current going in through, thus it controls the current passing into the fluorescent lamp. From the peak voltage and decreasing to zero, the capacitor discharges to the coil trying to hold the voltage at the coil from decreasing.

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Upon reaching zero voltage, the coil still have a stored magnetic field from the previous magnetic field direction. Hence the direction of electric current is still the same as with the first cycle going into.

20

This time the next half cycle is increasintg from zero to peak voltage in the other direction. Since the previous current is opposite in direction and coming from the stored magnetic field, the current in the next half cycle is opposed so that the current going into the system is drastically reduced into half if the resonant frequency is equal to the line frequency which is 60 Hertz.

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Therefore, the inductive reactance is primarily controlling the current into the fluorescent lamp by LENZ LAW. But the addition of current coming from the capacitor into the coil by its leading current explains that the capacitive reactance is virtually in series with the inductive reactance of the coil.

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5 CLAIM NO. 1

10 What we claim and sought to be protected by Letters Patent is the invention of the FLUORESCENT LAMP BALLAST COMBINED WITH ELECTRONIC STARTER AND RESONANT CAPACITOR. That constitute a primary coil, one terminal of which is directly connected to the powerline, a secondary coil is connected in series with the primary coil and in between the primary coil and secondary coil is directly connected to the filament, F_1 , of the fluorescent lamp, the other end of the secondary coil is connected to the secondary circuit which is the new kind of electronic starter.

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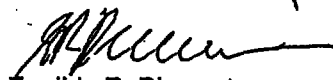
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CLAIM NO. 2

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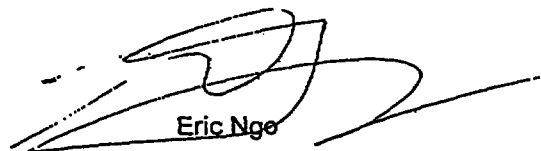
Another claim which we sought to be protected by Letters Patent is the invention of the new electronic starter incorporated into the system that constitute a capacitor connected into the secondary coil to create a high-starting-voltage, the other end of the capacitor is connected in series with a Quadrac, a semiconductor switch, for the switching on and off of charging a capacitor, the other end of Quadrac is directly connected to the other filament, F₂, of the fluorescent lamp, the triggering component of this invention for the Quadrac to switch on is the lone resistor that makes the secondary circuit becomes simple.

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