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FLUORESCENT ILLUMINATION

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Fig. 2

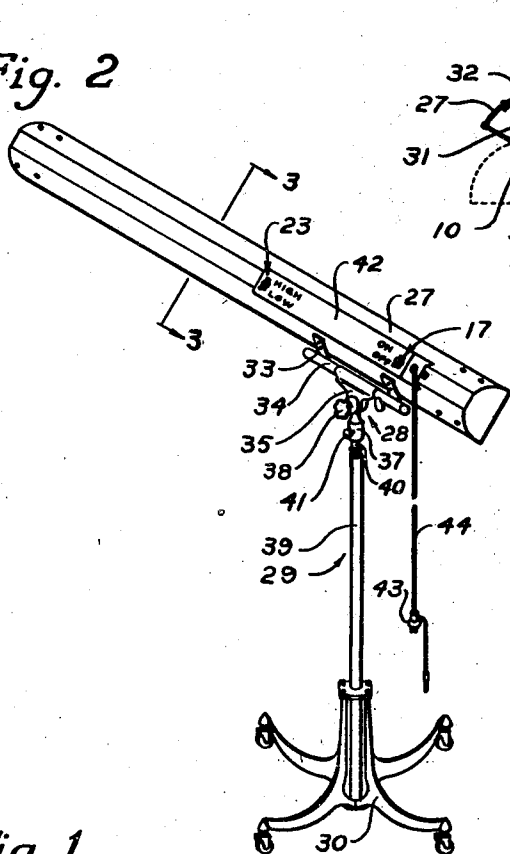


Fig. 3

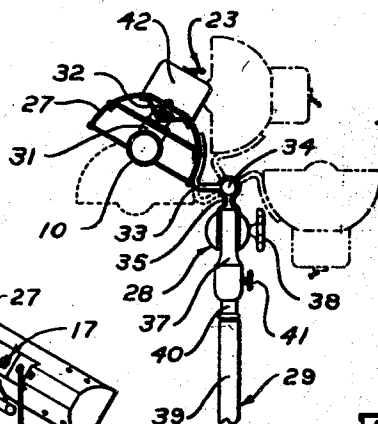


Fig. 4

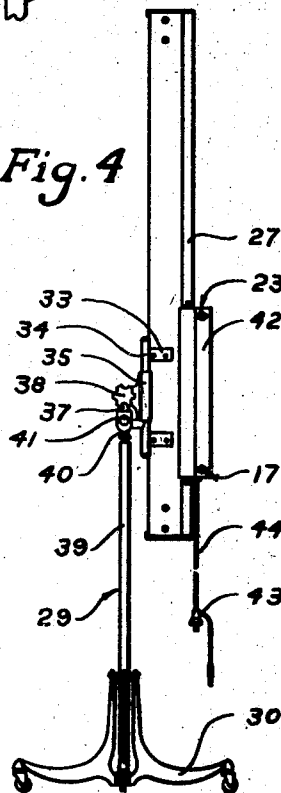
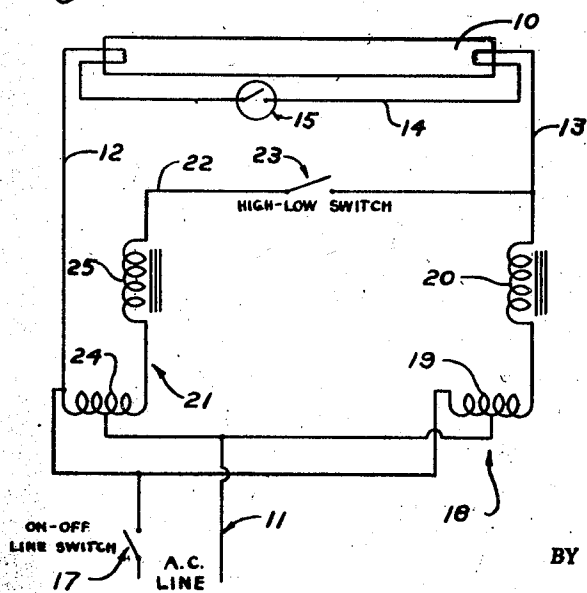


Fig. 1



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FLUORESCENT ILLUMINATION

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1

This invention relates to improvements in fluorescent illumination and more particularly concerns a new and improved method of and means for adapting a fluorescent light source for such uses as in photocopy work or the like where an intensity of illumination not normally attained with a fluorescent tube is requisite.

A prime consideration in photocopy work and especially for color reproduction, is the requirement for illumination of adequate intensity and color value to assure an accurate, clear, and sharp image of the subject upon the film or plate of the camera, with as nearly as possible true color separation. A real problem has been encountered, however, in satisfactorily attaining a proper combination of intensity of illumination and color value of the light. Carbon arc lights proved unsatisfactory due to the intense heat developed, and other limitations inherent in this form of illumination. Subsequently it was proposed to employ incandescent lamps in a bank of such number as to develop the necessary light. Such expedient is undesirably expensive, heavy, and cumbersome and also develops terrific heat and consumes a heavy load of current, as high as 400 to 500 watts in a typical unit.

Certain advantages in efficiency and lower current consumption are obtained in a later, widely used adaptation of the Cooper-Hewitt lamp employing a mercury vapor tube. Nevertheless, the Cooper-Hewitt lamp arrangement is encumbered with certain inherent deficiencies and objectionable characteristics. Among these may be mentioned a rather high current consumption, a unit comparable to a 400 or 500 watt incandescent unit using approximately 375 watts. A very cumbersome, heavy, expensive, and heat producing transformer arrangement is an essential part of the unit. There is also considerable weight in the unit as a result of the mercury in the lamp. The Cooper-Hewitt lamp is extremely critical as to position, failing to operate unless the lighting tube is disposed within critical angular limits to accommodate the mercury. Moreover the mercury vapor tube is unduly sensitive to abuse and thus liable to be damaged or destroyed. Although it is rather expensive both in the initial cost and in operation, it has but a disproportionately short period of usefulness for the intended purpose. Another serious disadvantage is that the direct light from the mercury vapor arc is preponderantly in the high frequency or blue-green-yellow range of the spectrum with corresponding deficiency, from a photography standpoint, in the lower frequency or red range. In consequence,

2

special filters must be employed for color correction, thus increasing the necessary exposure time and slowing the photocopy process.

5 An important object of the present invention is to overcome the various defects and deficiencies of the prior art by the use of fluorescent tube illumination.

Among other objects of the invention are the following:

10 To utilize standard forms of readily available fluorescent apparatus for successfully and in an improved manner illuminating subject matter to be copied photographically.

15 To provide a lamp for intense illumination purposes which uses but a fraction of the electrical current required for comparable prior units.

To provide a photocopy lamp unit having the characteristic freedom from operating heat inherent in fluorescent lighting.

20 To provide a photography lamp which can be used with a low or ordinary luminous output for preliminary or preparatory purposes and also with a high or greatly intensified light output for actual photographing.

25 To provide a light weight lamp unit of this character.

To provide a new and improved portable photocopy lamp unit which is relatively small, compact and of simple construction, which will occupy a minimum of floor space and can be easily and quickly moved about as required.

30 To provide a photocopy type of lamp unit which is substantially universally adjustable with respect to the subject to be illuminated.

35 To provide illumination, for photocopy purposes, of such quality as to attain superior color separation without the use of special color filters (except for unusual effects) and thereby save all of the additional exposure time heretofore required where filters have been necessary.

To provide a photocopy type of illumination source which is of unusually low initial cost and which will operate more economically than comparable prior light sources.

45 To provide a photocopy light source which is quite durable and relatively insensitive to abuse. Other objects, features, and advantages of my invention will be apparent from the following description and the accompanying one sheet of drawings, in which:

50 Figure 1 is a wiring diagram embodying features of the invention.

Fig. 2 is a perspective view of a photocopy type of lamp unit embodying the features of the invention.

3

Fig. 3 is an enlarged fragmentary sectional view taken substantially along the lines 3—3 of Fig. 2.

Fig. 4 is an elevational view of the lamp unit showing the head in a vertical position rather than horizontal as in Fig. 2.

Having reference to the exemplary wiring diagram in Fig. 1, a fluorescent lighting tube 10 is shown as deriving electrical current from an alternating current source through a line, indicated by the general numeral 11, and electrical leads 12 and 13 connected to the filaments at the respective opposite ends of the tube. As illustrated, the circuit is of such character that the fluorescent tube 10 may be of a standard variety readily available on the market, consisting of an elongated glass cylinder or envelop internally coated with a fluorescent material selected to emit light of the preferred quality. In brief, the internal coating of the envelope is adapted to fluoresce with a prescribed result when excited by a mercury vapor arc struck between the thermionic filaments located within the respective opposite ends of the tube.

A conventional starting circuit 14 connects the filaments of the tube 10 and has an automatically operating starting switch 15 therein. This starting circuit 14 operates in a well known manner to short circuit the path of arc between the filaments for a sufficient length of time after closing of a main circuit on-off switch 17 to provide for heating of the filaments as the result of resistance to passage of electrical energy through the filaments while the starting circuit is closed. Coincident with attainment of proper thermionic temperature of the filaments, the starting switch 15 opens, whereupon the lighting arc is struck between the filaments and the starting circuit 14 is cut out of further operation during maintenance of the arc.

As is customary in fluorescent lighting circuits, the principal circuit 12, 13 is provided with a current-controlling ballast 18. This is connected into one of the leads of the principal circuit, herein the lead 13 and preferably comprises an auto-transformer 19 and a choke coil 20, connected in series. Thus, when the line switch 17 is closed, a circuit is completed from one side of the line through the lead 12 and from the other side of the line through the lead 13 with the auto-transformer 19 stepping up the voltage slightly and the choke coil 20 supplying the required inductive voltage increase for starting the fluorescent tube 10 when the starting switch 15 snaps open. After the lighting arc has been struck through the fluorescent tube 10, the choke coil 20 operates, of course, as a filter to dampen possible fluctuations in the current.

Up to this point has been described merely an ordinary fluorescent lighting circuit wherein the fluorescent tube 10 is started with a momentarily multiplied voltage within permissible safe limits for which the fluorescent tube has been rated. In this way the fluorescent tube is saved from any unusual load or surge of current at the start which might have any tendency to cause premature deterioration of the filaments. Thereafter the running voltage with the circuit as thus far described will be that prescribed for the particular fluorescent tube being employed. For example, for a 100 watt tube the circuit voltage may be about 118. However, the lumens produced by this normal operation are insufficient under usual conditions for photocopy work.

It is my aim, therefore, to multiply the input into the fluorescent tube 10 and thus substan-

4

tially increase the lumens output of the lamp unit, but after the fluorescent tube has been safely ignited. In this I take advantage of the overrating customarily built into these tubes, that is the potentially greater brilliance of which they are capable than the standard brilliance when run at the prescribed rate. To this end, I increase the amperage of the current impressed across the fluorescent tube 10 at least to the extent which will effect up to the saturation point of lumens output of the fluorescent coating of the tube. Within the usual internal or coated surface area limits of a standard 100 watt white light tube this may mean as high as 50% increase over normal in the intensity of illumination. If desired, of course, the fluorescent tube may be of greater than normal internal fluorescing area so as to attain greater stepped up brilliance than with the standard size. While through my method of securing increased illumination the life of the fluorescent tube is considerably shortened in comparison with its normal life expectancy if run at normal pressure, this is tolerable and really no loss when considering the very desirable results attained.

According to the invention, supplementary means is provided in or in conjunction with the principal circuit and is adapted to be placed in operation for effecting the multiplication of input referred to after the fluorescent tube has been ignited. In a desirable form, such means comprises a second ballast 21 connected in parallel with the initial or normal ballast 18 through the medium of a supplementary or multiplying circuit 22 controlled by a switch 23.

In operation, after the fluorescent tube 10 has been ignited through the medium of the starting circuit 14 and the initial ballast 18, as heretofore described, the multiplying circuit switch 23 is closed. This cuts in the multiplying circuit 22 and to a controlled extent increases the flow of current to the fluorescent tube 10. For this purpose the supplemental ballast 21 has, in a typical installation in practice, been an identical counterpart of the initial ballast 18, and has comprised an auto-transformer 24 and a choke coil 25. However, the supplementary current input into the fluorescent tube 10 can be selectively varied within certain limits by appropriate selection of the effective supplementary ballast elements such as the auto-transformer 24 and the choke coil 25. In the aforementioned typical installation where the fluorescent tube 10 drew a normal running current of approximately .87 ampere, the cutting in of the multiplying circuit 22 caused the delivery of a current of approximately 1.5 amperes through the circuit.

The supplementary circuit switch 23 may be referred to for convenience as a "high-low" switch because when it is open the fluorescent tube 10 is operating on low current or input and when the switch is closed the tube operates on high input. Stated in other words, when the high-low switch 23 is open, the tube 10 operates at low or normal luminosity on current passed by the initial ballast 18 while when the switch is closed the tube is characterized by its greatly increased brilliance or high luminosity as a result of the additional current passed by the supplemental ballast 21.

An important industrial application of my invention is in a lamp unit for photocopy work, an exemplary practical form of which is shown in Figs. 2, 3, and 4. This lamp is portable, of relatively light weight so that it can be easily shifted

5

around as required, and practically universally adjustable with respect to the subject to be copied or photographed. It comprises a reflector hood 27 removably supporting the elongated fluorescent tube 10 and is carried adjacent to one end substantially cantilever fashion by an adjustment head 28 disposed at the top of a vertically adjustable standard 29 mounted upon a preferably caster-equipped portable base 30. By preference, the fluorescent tube 10 should be of the largest size commercially available so as to attain maximum illumination value through the use of a single tube in the lamp, thus adding compactness to the other attributes of the lamp. The largest presently available fluorescent tube is rated at 100 watts, about 4,000 lumens, and is about 60 inches long. The reflector hood 27 is therefore of ample length to receive the fluorescent tube 10 between appropriate terminal supports 31 and is of such calculated radius and internal construction as to afford the best practicable concentration of light for the intended purpose. Reflected light rays which might be blocked by the fluorescent tube 10 are deflected past the tube by an angular surface arrangement behind the tube, parallel and substantially co-extensive therewith within the reflector hood and in the present instance comprising a member 32 having deflecting surfaces converging on the diameter of the tube substantially as shown in Fig. 3. The deflector 32 also provides a convenient channel or conduit for supporting electrical wiring for the fluorescent tube circuit. Substantial universality of adjustment relative to the subject to be photographed is attained for the reflector 27 through the particular manner of mounting employed. To this end the supporting head 28 is formed of a bracket 33 attached to the hood 27 and comprising in the main a fixed cylindrical swivel shaft 34 which is engaged by a releasable clamp 35 secured to a head body 37 by means of a rotary locking member 38 having a conveniently manipulatable hand wheel head. The clamp 35 can be loosened enough to adjust the reflector hood 27 to any desired incremental position through an arc of 180 degrees about the axis of the shaft 34. Several such positions of adjustments being indicated in Fig. 3 in full and broken outline.

Swinging adjustment of the reflector hood 27 vertically through 90 degrees from a horizontal position as shown in Fig. 2 to a vertical position as shown in Fig. 4 is accomplished by having the clamp 35 mounted rotatably on the axis of the hand wheel locking member 38 and under the control of the locking member. Moreover, light can be thrown from rather high up because due to the substantially eccentric or cantilever mounting of the deflector 27 it extends to a considerable height when tilted up on end. Also as a result of this eccentricity the reflector can be adjusted freely over a wide area to one side of the supporting stand and standard.

To enable elevational adjustment of the reflector 27, the standard 29 is preferably constructed of telescopic members which may comprise an outer tube 39 fixed in upright position to the base 30, and an inner telescopic member 40 fixed to the head body 37 and vertically slidable within the outer tube 39 throughout a substantial range of vertical adjustment. Any preferred condition of relative vertical adjustment of the standard elements 39 and 40 is adapted to be maintained through the medium of internal locking or sustaining structure or mechanism (not shown) of any preferred form under manual control of

6

means such as a manually operable knob or button 41 conveniently disposed on the head body 37. By preference the inner telescoping member 40 of the standard is rotatable at will within the outer member 39 so that the lamp reflector may be swung about the standard axis as needed.

Inasmuch as the ballasts 18 and 21 are of relatively small size and compact they are preferably arranged in elongated form and mounted directly upon the reflector hood 27 enclosed within an elongated cover 42 which may be removably secured longitudinally upon the back of the hood 27. For purpose of stability the ballast assembly is preferably located so that its center of mass is as close as practicable to the axis of the standard 29. Connection with an electrical source outlet is adapted to be conveniently effected through the medium of a plug 43 carried by an electrical cable or cord 44.

For the convenience and guidance of the user, the switches 17 and 23 are located in readily accessible well separated positions on the lamp unit and are appropriately identified. In a preferred arrangement the switches are assembled with the ballast structure adjacent to the respective opposite ends of the cover 42 as seen in Fig. 2 and have suitable switch-operating levers projecting from the cover. Proper legends identifying the line switch 17 by "On-off" or the like and the auxiliary circuit switch by such wording as "High-low" are preferably provided on the cover 42 adjacent to the respective switch operators.

From the foregoing it will be apparent that I have provided a lamp construction which is unique in several respects. Although the method and means whereby the increased luminosity of the fluorescent tube is attained has many obvious useful applications, the outstanding results obtained in the photocopy field demand special attention. In a unit comparable in luminosity to a Cooper-Hewitt unit rated at about 375 watts, a commercially available 100 watt fluorescent tube will give entirely satisfactory results when stepped up to about 180 to 200 watts. Instead of a heavy, cumbersome and profusely heat emitting transformer arrangement as required for operation of a Cooper-Hewitt lamp, the present lamp is adapted to be equipped with but a small, compact relatively light weight ballast unit which can be conveniently mounted directly on the reflector hood. The amount of heat generated by the ballast and the fluorescent lamp is quite insignificant so that where the lamp is used in relatively confined quarters as in a photographic studio or a photocopy work shop a much higher degree of comfort may prevail with respect to temperature than has prevailed with prior expedients. The small compact form of the lamp hood and its practically universal adjustment are of great advantage to the user, since the illumination source can thus be maneuvered with great freedom into precisely the position with respect to the subject under illumination deemed most desirable by the user. The fact that white illumination values are attainable with high fidelity affords a substantial advantage in that for photocopy purposes, especially in certain color ranges, the prior need for use of filters is eliminated, thus substantially speeding up the work by reducing the exposure time required. Another advantage that must be accorded due importance is the fact that since the present lamp will operate optionally at low or high intensity of illumination, it lends itself pre-eminently to use for pre-photographing illumination of the subject

7

with normal intensity light and without the glaring brilliance which is necessarily incident to the maximum illumination developed by the lamp for actual photographing after the supplementary ballast circuit is closed by throwing the high-low switch to high position. After the subject has been photographed, the lamp need not be shut off entirely but merely by opening the high-low switch 23 the illumination can be cut back to normal until photographing illumination is again called for. The life of the fluorescent tube is thus extended rather than shortened as would be the case were it to be shut off altogether and then restarted over and over again during a working period.

While I have illustrated and described a certain preferred embodiment of my invention, it is to be understood that I do not thereby intend to limit my invention to the specific details disclosed, but contemplate that various modifications, substitutions, and alternative constructions may be effected without departing from the spirit and scope of the invention as defined in the appended claims.

I claim:

1. A fluorescent lighting circuit comprising a fluorescent lamp, a choke coil and auto transformer connected in series with said lamp, starter means, and means for increasing the intensity of illumination of said lamp, said means comprising a choke coil and auto transformer connected in series with each other but both connected in parallel with said first mentioned coil and transformer, and a switch for selectively connecting said last mentioned coil and transformer into said circuit.

2. A fluorescent lighting circuit comprising, in combination, a fluorescent lamp, starter means connected across the terminals thereof, a current ballast including a choke coil and auto transformer connected in series with said lamp, and means for increasing the intensity of illumination of said lamp, said means including an auxiliary ballast comprising a series of connected choke coil and auto transformer connected in parallel with said first mentioned ballast, and switching means for selectively connecting said auxiliary ballast into said circuit.

8

3. A fluorescent lighting circuit comprising, in combination, a fluorescent lamp, starter means connected across the terminals thereof, a current ballast including a choke coil and auto transformer connected in series with said lamp, means for multiplying the current input into said lamp to increase the lumens output thereof, said means comprising a choke coil and auto transformer connected in series with each other but both connected in parallel with said first mentioned current ballast, and switching means for selectively connecting said last mentioned coil and transformer into said circuit.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
2,392,845	Foerste	Jan. 15, 1946
1,930,123	Ewest	Oct. 10, 1933
2,298,935	Freeman	Oct. 13, 1942
1,994,305	Dorgelo	Mar. 12, 1935
2,114,842	Inman	Apr. 19, 1938
2,018,254	Dobrusskin	Oct. 22, 1935
2,178,423	Inman	Oct. 31, 1939
1,744,370	Dietz et al.	Jan. 21, 1930
2,286,851	Hess	June 16, 1942
2,297,781	Korengold	Oct. 6, 1942
2,332,770	Abernathy	Oct. 26, 1943
2,258,354	Doane	Oct. 7, 1941
1,291,945	Libson	Jan. 21, 1919
D. 136,799	Vendope	Dec. 7, 1943

FOREIGN PATENTS

Number	Country	Date
386,552	Great Britain	1933

OTHER REFERENCES

Chanon & Barr, Some engineering aspects of lighting from cold-cathode fluorescent sources, Illuminating Engineering, vol. 37, Dec. 1942, pages 769-788, especially pages 772, 773 and 780.