ACCELERATED WEATHERING APPARATUS

BACKGROUND OF THE INVENTION

This invention pertains to the art for testing specimens for fastness and deterioration under light, and more particularly, to such an apparatus using discharge lamps as light sources.

This invention is particularly applicable to testing of specimens using fluorescent ultraviolet lamps to simulate the deterioration caused by sunlight and will be described with particular reference thereto. However, it will be appreciated that the application has broader applications and may be advantageously employed in apparatuses using xenon lamps and in connection with many other accelerated weather testing concepts and uses.

A conventional testing apparatus using discharge lamps as shown in FIG. **1** has eight ultraviolet fluorescent lamps **10** provided in a test chamber **12** and arranged into symmetric downwardly divergent rows when viewed in cross-section. Specimens **14** to be tested are attached to two opposite specimen supporting walls of the housing of the test apparatus so as to face inwardly toward the fluorescent lamps and receive the light irradiance therefrom. In the machine shown, there are two specimens, an upper and lower one. However, there may be only a single specimen or more than two. The rear surfaces of the specimens **14** are exposed to the atmospheric air outside the machine. Outside air is heated and blown into the interior of the chamber **12** to regulate the temperature in the chamber **12**. Water in moisture supply tank **16** is made hot and evaporated to supply moisture into the chamber **12**.

In the above-described testing machine, one example of the machine's operation includes applying ultraviolet rays to the specimens **14** at a temperature of 60° C. for 16 hours and the fluorescent lamps **10** are turned off and the interior of the chamber **12** is kept at 50° C. for eight hours. These two steps, which constitute one cycle of a deterioration testing operation, are repeated continuously. While the fluorescent lamps are off, the humidity in the chamber **12** is high, and the rear surfaces of the specimens are exposed to the outside air at a low temperature. Accordingly, the surface of the specimens are wetted due to condensation. Thus, the wetting of the specimens, the applying of ultraviolet rays, and the drying are repeated, which speeds the deterioration of the specimens. It is to be appreciated that the above description is just one type of cycle for which machines of this nature can be used.

Problems, however, exist with the apparatus shown in FIG. **1**. Initially, there is no provision for sensing the output of the fluorescent lamps **10**, in order to track their rate of degradation. A normal procedure for attempting to provide a uniform output from the lamps, in such a device, is to rotate the positions of the lamps at predetermined time intervals in a predetermined sequence. Testing of the lamps to detect actual output is not provided, rather, assumptions are made as to the likely output, and the rotation sequence is made in consideration of the assumptions.

An additional drawback of this type of device is that the discharge lamps **10** which are located on one side of the chamber **12** transmit light beams to the opposite side of the chamber. For example, the row of lamps on the left side of the chamber in FIG. **1** are intended to produce irradiance for the specimen **14** also on the left side of the chamber. However, these lamps also produce beams in an undesirable fashion on the specimens **14** On the right hand side of the chamber **12**. These undesirable beams tend to concentrate towards the middle of the specimen supporting wall. Therefore, a common problem is having the specimens which are located nearest the middle of the testing apparatus receiving higher doses of irradiance than those specimens arranged toward the top or bottom of the apparatus. This decreases the uniformity with which irradiance is transferred to the specimens.

Various attempts have been made to improve on the above-noted drawbacks of the conventional testing apparatus shown in FIG. **1**. Among these is an apparatus from Atlas Electric Devices Company, called Atlas Ci35 FADE-OMETER ®; an apparatus from Heraeus called XENOTEST ® 1200 CPS; U.S. Patent to Suga, U.S. Pat. No. 4,544,995 issued Oct. 1, 1985; and U.S. Patent to Kockott, et al., U.S. Pat. No. 4,544,995 issued Apr. 27, 1971.

The Atlas device is arranged for use with a xenon arc lamp and includes a closed loop irradiance monitor as its primary light control system. The monitor, using a light pipe, interference filter and photosensitive diode feeding into solid state electronics, maintains predetermined irradiance levels and totalizes the energy received by the samples through an integrator. This device is also equipped with manual irradiance controls for use when periodically calibrating the system.

The apparatus from Heraeus is also directed for use with xenon arc lamps. This device employs three light detectors to detect the output of three individual xenon arc lamps.

A conventional apparatus including elements of these two above-discussed devices is shown in FIG. **2**. In this Figure, discharge lamps **30** which can be of a xenon type, are vertically disposed. A filter **32** surrounding the discharge lamps **30** is provided to allow only desired wavelengths of light to pass. Sensors **34** are provided to sense the output of the vertically positioned discharge lamps **30**, and a rotating specimen holding rack is positioned to encircle the discharge lamps **30**. Each of the detectors **34** are provided to detect the irradiance produced from a respective discharge lamp **30** over time. The rotating specimen holding rack **36** rotates the specimens located in the specimen holding rack **36**. The sensors **34** are provided to track the output of the discharge lamps **30**, and the rotating specimen holding rack **36** attempts to provide each of the specimens with an average overall equal amount of irradiance. Inner walls **38** are used to direct reflective light of the discharge lamps **30** outward to the specimens.

Another device, employing ultraviolet lamps in an arrangement similar to FIG. **1**, is known to include a single sensor. However, in such an arrangement it is necessary to match the characteristics of the lamps prior to placing them in such a device. This is required since the sensor will only sense the lamps closest to its location. Thus, the sensor will assume the lamps placed distant from it are operating the same as the lamps it actually senses.

The Suga patent attempted to improve on the prior art device shown in FIG. **1** by adjusting the alignment of the row of discharge lamps **10** of FIG. **1** into a nonsymmetric arrangement. This arrangement is shown in FIG. **3**. As noted in this Figure, the discharge lamps **10** are not disposed immediately below each other. Rather,