United States Patent Office

3,426,590

Patented Feb. 11, 1969

1

3,426,590

APPARATUS FOR EXPOSING SAMPLES TO LIGHT

Nagaichi Suga, 2 Toyama-cho, Shinjuku-ku, Tokyo, Japan

Filed Nov. 10, 1964, Ser. No. 410,074

U.S. Cl. 73—150 7 Claims

Int. Cl. G01n *17/00;* G01j *3/14*

This invention relates to an apparatus for exposing samples to light of various wavelengths, and more particularly to an apparatus which is quite simple yet can expose samples to many different combinations and permutations of different wavelengths of light.

It is well known that almost all materials fade or deteriorate with exposure to light. However there are many substances, particularly among the recently developed synthetic fibers, dyestuffs and pigments, which fade or deteriorate much more rapidly when exposed to light which includes light of specific wavelengths.

While most light ageing of materials is due to exposure of the materials to solar radiation, the spectral distribution of the light in solar radiation is not uniform at all times. For example, synthetic materials of the propylene class are known to suffer relatively great damage due to exposure to solar light during the six month period from March to August in the northern hemisphere, while very little damage is observed during the remainder of the year. This can be explained by the fact that ultraviolet rays in the shorter range of 290 mμ produce a photochemical effect in propylene, and the amount of radiation in this range which is present in sunlight in the winter months is very much less than in the summer months.

Because of this variation in the composition of solar radiation, if it is desired to test a sample full, it is necessary to expose it to sunlight for at least a full year. If it is desired to accelerate the exposure process, some provision must be made for providing a source of light which can have the composition thereof varied in the same manner that natural solar radiation varies.

Moreover, it is often desirable to determine the wavelength of the radiations which play the important role in the ageing of a particular material, or the particular wavelengths and their proportional amounts in light of a certain composition which have the greatest ageing effect on a particular material. For example, the material sold under the name Teflon, a trademark of E. I. du Pont de Nemours & Co. for a plastic consisting of tetrafluoroethylene polymer is known to suffer from exposure to solar radiation in amount of $1,215 \times 10^3$ Kcal./m.^{2} year. However, the weathering in this instance is not caused uniformly by the light over the whole scale of wavelengths, but rather is mostly caused by light of the following composition:

290–310 mμ (A range) ----------	200×10^3 Kcal./m.^{2}
450–480 mμ (B range) ----------	30×10^3 Kcal./m.^{2}
550–610 mμ (C range) ----------	5×10^3 Kcal./m.^{2}

Thus, of the $1,215 \times 10^3$ Kcal./m.^{2} of solar energy, it is the energy produced by the light of the above composition with the light in the A, B and C ranges that does most of the damage. In other words, 235 Kcal./m.^{2} of light containing only radiation in the A range, B range and C range, and in the proportions 200:30:5 has substantially the same damaging effect on the material as the entire amount of solar radiation.

In addition, the percentage of ageing which is caused by these radiations is not directly proportional to the proportion of radiations in the light, it being known that the radiations in the A range plus the B range cause 60% of the ageng, while the A range by itself causes 50%, the B range 5% and the C range 2%.

2

Heretofore, testing apparatus for testing the ageing characteristics of materials in light have used arc lamps, xenon lamps, and mercury arc lamps as sources of light, and these light sources are designed so as to have a spectral energy distribution similar to natural solar radiation through the whole range from ultraviolet to infrared. These sources of light have been used in combination with means for controlling temperature, humidity and rainfall in order to test samples without the necessity of exposing them to natural solar energy. However, these devices have not, without the addition thereto or the inclusion therein of complex controls, filters, etc. been able to provide light of different specific wavelengths for subjecting samples to only these specific wavelengths, or to produce permutations and combinations of groups of wavelengths less than the entire spectrum of the light source. With the increased activity in research on photochemical reactions and the necessity for light sources which can be varied in many different ways, it is desirable to have a simple apparatus in which the light source can be controlled in order to produce light of different wavelengths and having different proportions.

It is an object of the present invention to provide an apparatus which is relatively simple yet which is capable of producing visible radiations of different frequencies and permutations and combinations of visible radiations having different frequencies.

It is a further object of the present invention to provide an apparatus for testing samples for light fastness which is relatively simple yet which is capable of producing various types of light in different proportions and at different wavelengths for testing samples under varying conditions of exposure to natural solar radiation.

Other and further objects of the invention will be made clear from the following specification and claims, taken together with the accompanying drawings, in which:

FIG. 1 is a sectional elevation view of a preferred form of the apparatus according to the present invention;

FIG. 2 is a top plan view of the apparatus of FIG. 1 with a part of the cover broken away to show the arrangement of the parts inside the apparatus;

FIG. 3 is a schematic view, on an enlarged scale, of one of the optical systems in the apparatus; and

FIG. 4 is a view similar to FIG. 3 the optical system of FIG. 3 rotated 90° about its own axis.

As seen in FIGS. 1 and 2, a generally cylindrically housing **20** has mounted centrally therein a xenon lamp **1** and around the lamp is a polygonal lamp casing **21** in which are mounted a plurality of lenses **2** which act as condenser lenses for the several optical systems which will be described hereinafter. Each optical system is contained within a cylinder **16** which is radially mounted in the housing **20** and which is rotatable around its own axis. A rotatable sample holding drum **22** is rotatably mounted around the central cylindrical lamp casing **21**, and the drum has a generally cylindrical surface **6***a* on which a plurality of first sample holding means **6** are positioned, and a truncated conical surface **7***a* on which a plurality of second sample holding means **7** are positioned. Positioned beneath the control cylindrical lamp casing **21** is a blower system having a fan **12** driven by a motor, in this instance an electric motor **13**. The sample holding drum **22** is also driven from the motor **13** through a pulley **10** on the end of the motor shaft, the pulley **10** being coupled to a pulley **9** on shaft **9***a* by a belt **10***a*, and the shaft **9***a* having a means **8** on the end thereof opposite the pulley **9** which is coupled to the shaft portion **23** of the drum **22**, in this instance the means **8** being a set of gears and there being a gear **24** on the shaft portion **23** of the drum **22**.

Also provided within the housing **20** are humidifier means **11**, an air intake filter **14**, grids **27** and **28** for