INTEGRATING SPHERE TYPE STANDARD LIGHT SOURCE DEVICE

The present invention relates to an integrating sphere type standard light source device, and more particularly to such a device which is especially useful for observing the brightness and vividness of the color of a metallic powder specimen or an anodized aluminum specimen.

BACKGROUND OF THE INVENTION AND PRIOR ART

In visually inspecting the colors of industrial products, such as those which are coated with paint, plastic materials, colored aluminum and the like, it is often necessary to compare slight differences in colors. Heretofore, inspections of this sort have been conducted under natural daylight, or by means of a standard light source employing an artificial source of light.

For comparing colors under natural daylight, it is recommended that the inspection be carried out during the period from three hours after sunrise to three hours before sunset. The natural daylight during this period varies continually, however, depending upon the season, weather conditions and time, making it difficult to obtain a constant condition. Preferably, therefore, artificial illumination by a standard light source is used for industrial applications.

In conventional standard light-source equipment, the color is visually observed from a position at an angle of 45° to the surface of the specimen while light from a source of light directly above the specimen is directed on the upper portion of the specimen, the source of light being a xenon lamp, a fluorescent lamp having a color temperature of 6500° K. and D65 light characteristics as specified by JIS and CIE (International Committee of Illumination), or a tungsten incandescent lamp.

FIG. **1** shows a conventional example of a simply constructed standard light source device, in which a fluorescent lamp **3** having D_{65} light characteristics is disposed above an illuminating opening in a floor **2** of a light source chamber located in the upper portion of a housing **1**, a ground glass plate **4** is mounted in the illuminating opening, a specimen **5** is placed at the center of the bottom surface of the housing **1**, and the color is observed through the opening in the front of the housing from the direction of arrow **6** at an angle of about 45° with respect to the surface of the specimen.

The light from the light source **3** is scattered by the ground glass **4**. Most of the light illuminating the specimen **5**, however, travels in one direction from above the specimen as indicated at **7**. If the specimen is observed from an angle of 45° as indicated by arrow **6** under these conditions the light is scattered as indicated at **8**, and only the light reflected at the angle of 45° by the surfaces of the specimen **5** enters the eyes, and the light reflected in other directions as designated at **7'** does not enter the eyes. Since the fluorescent lamp always illuminates the specimens with a predetermined amount of light so that a predetermined amount of reflected light will enter the eyes, the abovementioned standard light-source device has been so widely used that it has become indispensable for visually inspecting and comparing the colors of products.

Although the described device is very useful for inspecting coated products in general, plastic products, fibrous products and the like, it is not now useful for comparing the colors of automobiles and building materials in which abundant uses are made of metallic coatings and colored oxide-film aluminum which exhibit special visual effects due to the use of such optical characteristics as double reflection consisting of irregular reflection by the surface and directive regular reflection, and polarization. Namely, when such coatings are illuminated by light incident from only one direction as employed in conventional devices, the amount of reflected light entering the eyes, i.e., the color, changes even with a slight change in the relative position of the eyes and the specimen, making it difficult to compare the colors. Therefore, products which have passed inspection carried out by the above-described device often turn out to be defective after shipment.

This is caused by the fact that the light illuminating the specimen is unidirectional, which is different from natural daylight.

The reflection characteristics of a metallic powder coated layer and an anodically oxidized film layer of colored aluminum are shown diagrammatically in FIGS. **2** and **3** and will now be discussed. Referring to FIG. **2**, a fine metal powder **12** of a material such as aluminum is dispersed in the upper portion of a transparent resin layer **11** on the metallic coating. Although the reason is not clear, the fine metal powder is oriented in a given direction. If the light **13** is incident from a given direction, the light is reflected from the surface of the resin layer and scattered by the surfaces thereof as at **14** and an intense light **15** is reflected by the oriented fine metallic powder **12** and transmitted through the transparent resin layer **11**. Therefore, when viewed from the direction toward which the regularly reflected light **15** is reflected, a glaring color specific to the metallic coating will be seen. This color, however, will not be seen from other angles. In the case of colored aluminum shown in FIG. **3**, if the light **21** is incident from a given direction, the light is reflected and scattered by the surfaces of the anodic coating **23** as at **22**, and an intense light **25** is reflected by the metallic aluminum and transmitted through the anodically oxidized film layer **23**. Therefore, when viewed from the direction toward which the intense reflected light **25** is reflected, a dense and vivid color specific to the colored aluminum will be seen. This color, however, will not be seen from other directions. Further, the phenomenon of polarization develops depending upon the thickness of the anodically oxidized film layer and the kinds of dyestuff. For instance, a yellowish incident light, when reflected, may often be seen as being greenish in color.

On the other hand, under bright daylight i.e., when illuminated from all directions by light irregularly reflected by surrounding buildings and the ground and by light reflected in a scattered manner by dust and dirt in the sky and clouds as a result of the incident sunlight, the observer will invariably see evenly scattered light and evenly reflected intense light reflected by the metallic coating or colored aluminum even when the position of the observer is changed. That is, a color having optical characteristics specific to the coating will be seen. This is the color feeling that people perceive outdoors or indoors from automobiles having metallic coatings and high-rise buildings and the like coated with anodically oxidized colored aluminum.

Therefore, the colors of such products cannot be correctly compared by a conventional standard light-source device which radiates light from one direction only, and differences in color is often not discernible, because only the light that is scattered and directionally