124 is threaded in the adjustable sleeve to secure the lens elements in position.

It will be seen that a common light path is provided from the viewing mirror through the diffusing sphere exit port, through the polycrometer and to the sensor. This common optical path in time shared by means of the sequential viewing provided by the pivotally positioned mirror.

As illustrated in FIG. 7, overall timing control of the system shown in FIGS. 3, 4, 5 and 6 is provied by a timing control circuit 126 that generates signals to drive the port selector (illustrated in FIG. 4 as motor 112 and gearing 98, 114), to position the pivotal mirror for viewing of a selected port in diffusing sphere 26. Light transmitted from the selected target is reflected by the mirror to the polychrometer 64 where it impinges upon the face 76 of the vidicon sensor tube 66. The vidicon sensor tube is provided with a scanning beam that is driven from a scan control generator 128 and vertical and horizontal deflection circuits 127, 129 timed from the timing control 126. The scan control generator causes the scanning beam to deflect at a relatively slow rate horizontally across the face of the tube and to deflect vertically at a more rapid rate to provide a scan such as indicated at 130 in FIG. 7. Each complete vertical scan covers but a single sensor element (distance "d") of the face of the sensor tube. Accordingly, where there are 300 such elements in a distance of 0.500 inches on the face of the tube and where the spectrum from 400 to 700 nanometers covers 0.500 inches, each scan covers a single nanometer.

The vidicon scanning beam provides an electrical signal having a magnitude directly related to the intensity of the impinging optical energy. This signal is fed to an integrator 132 which accumulates the electrical signal of the scanning beam over a single full vertical scan (the scan of a single nanometer). The output of the integrator over each scan is held in a clamp 134 and fed to an analog-digital converter 136 that stores in a computer and processing circuit 138 the digital value of each vertical scan. Suitable gating (not shown) may be employed so as to obtain measurements at selected sampling points rather than at each and every scan. Thus, the sytem may be arranged to provide, for example, 15, 30 or 60 sample points over the 300-nanometer spectrum. When employing 15 sample points, each 20 scan would be read into the integrator, with scans between such 20 scans not being used. Similarly, for a finer resolution of measurement, 60 sample points may be employed wherein each 5th vertical scan of the vidicon would be integrated, digitized and stored for use in the computation. It will be readily undestood that, during the viewing of any single target, the vidicon beam will deflect through a number of complete horizontal scans for signal enchancement. During each such horizontal scan, selected vertical scans at each of the sample points are integrated, digitized and stored. From the storage, the arithmetic processing described above may be readily accomplished. Such processing will include the subtraction of the black body noise (stray light and electrical noise) signals at each sampled spectral point from both the target and white standard signals, and the division of the sample signals by the white standard signals to obtain the reflectance ratios, each such arithmetic operation being accomplished for each sample point.

Obviously, additional computation processing and display may be employed as deemed necessary or desirable. Suitable computation can be carried out by general purpose or by special purpose computers to automatically compute the desired tristimulus values and/or chromaticity coordinates and provided suitable displays of these and other parameters as required.

Although the described arrangement uses reflected energy from reflective targets, it will be appreciated that these methods and apparatus can be readily modified to provide equivilent measurements using light transmitted through targets having appreciable light transmitting capability.

There have bbeen described methods and apparatus for accurate measurement of radiation intensity and in particular, for accomplishing reflectance measurements for color analysis in a manner the affords extremely rapid measurement capabilities, employing a common optical path, no critical moving parts and elimination of noise, including stray light noise.

The foregoing detailed description is to be clearly understood as given by way of illustration and example only, the spirit and scope of this invention being limited only by the appended claims.

What is claimed is:

1. The method of making color measurements comprising the steps of

impinging light from a light source upon a standard and a sample,

collecting light from said light source that is transmitted along at least one optical collection path from said standard and from said sample,

generatiing first and second signals indicative of collected light transmitted from said standard and sample respectively,

generating a noise signal indicative of stray light included in said collected light,

said stray light including light in said optical collection path derived from said source, and

differentially combining said noise signal with each of said first and second signals so as to yeild third and fourth signals indicative of light transmitted from said standard and sample respectively as corrected for the presence of stray light.

2. The method of claim 1 including the step of dispersing light from said source into a spectrum, said steps of generating signals comprising the steps of generating said signals at each of a number of points of said spectrum, and wherein said step of combining comprises combining said noise and said first and second signals at each of said points of said spectrum.

3. The method of claim 2 wherein said step of dispersing light comprises dispersing light transmitted from said standard and from said sample.

4. The method of claim 3 wherein said step of collecting comprises the step of illuminating a light-sensitive area with said dispersed light transmitted from at least one of said standard and sample, and wherein said step of generating said first and second signals at said points of said spectrum comprises the step of generating electrical signals indiciative of intensity of illumination of points on said area corresponding to said points of said spectrum.

5. The method of claim 4 said light-sesnitive area comprises at least part of an image tube having a readout beam, and wherein said step of generating electrical signals comprises sweeping said readout beam