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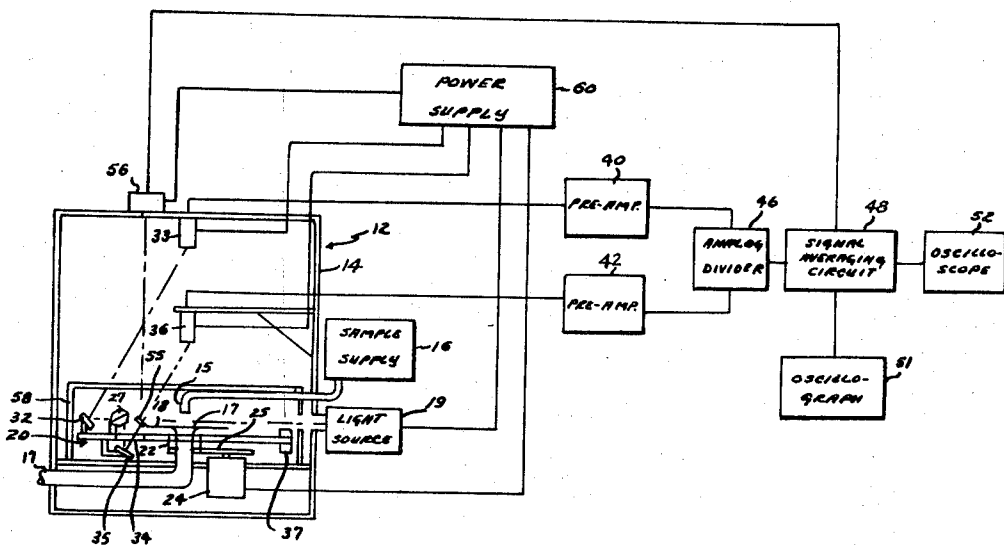
[54] **SCANNING SCATTERED LIGHT PHOTOMETER**
5 Claims, 4 Drawing Figs.

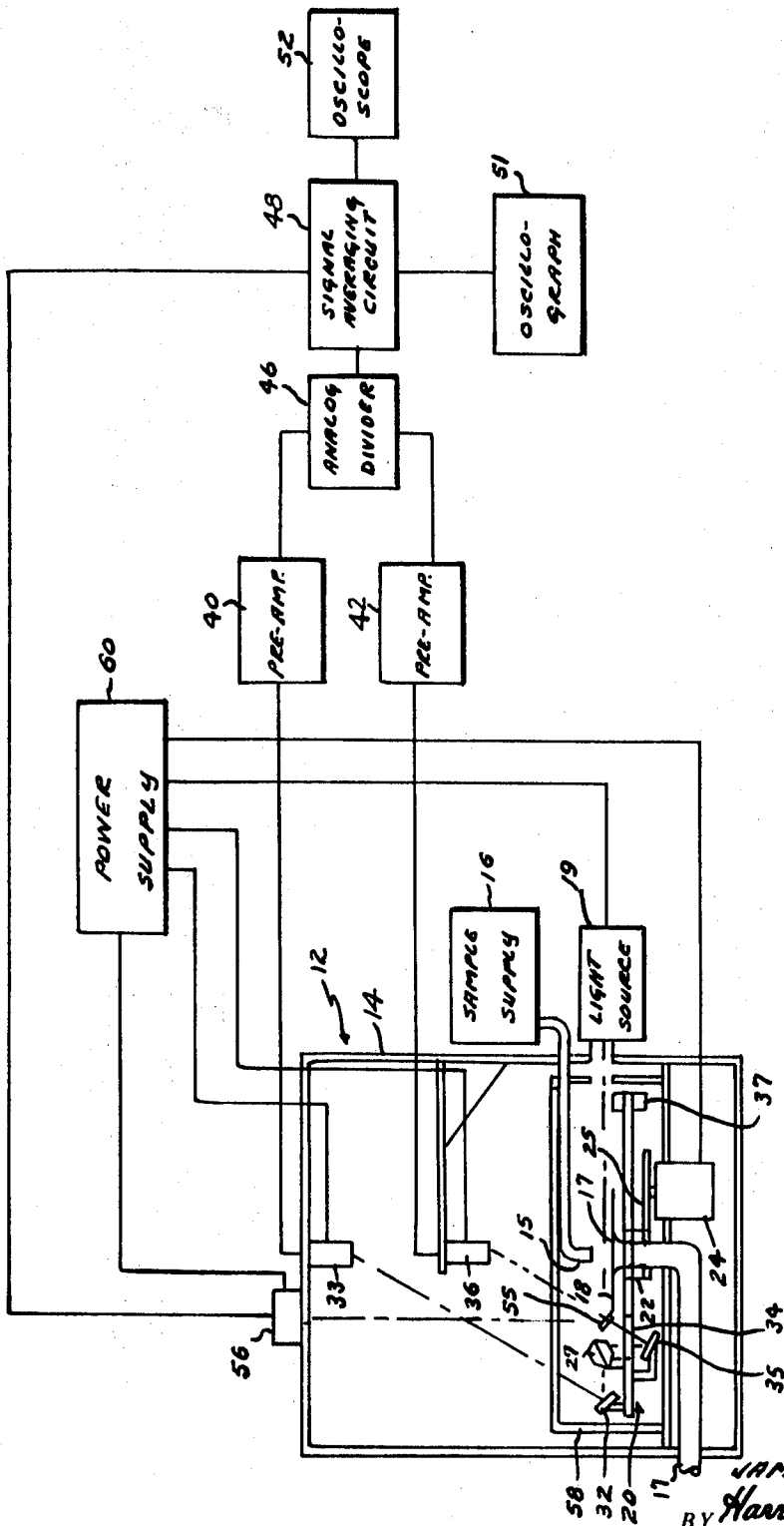
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356/114
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ABSTRACT: A scanning scattered light photometer system having a rotor with a beamsplitter-polarizer and a nozzle for directing an aerosol flow along the axis of the rotor toward an exhaust outlet. The aerosol flow is illuminated by a collimated monochromatic unpolarized light. A polarizing beamsplitter on the rotor separates the scattered light into two perpendicular components. A first mirror on the rotor directs a first polarized component of light in the plane of rotation of the rotor toward a first photomultiplier. A second mirror on the rotor directs light polarized perpendicular to the plane of rotation toward a second photomultiplier. A fixed mirror directs undispersed light toward a photoconductive device to provide a synchronizing output pulse when the polarizer beamsplitter passes through the beam between the light source and the aerosol flow. The outputs of the photomultipliers and photoconductive device are fed to a ratio and averaging circuit and then to a recorder.





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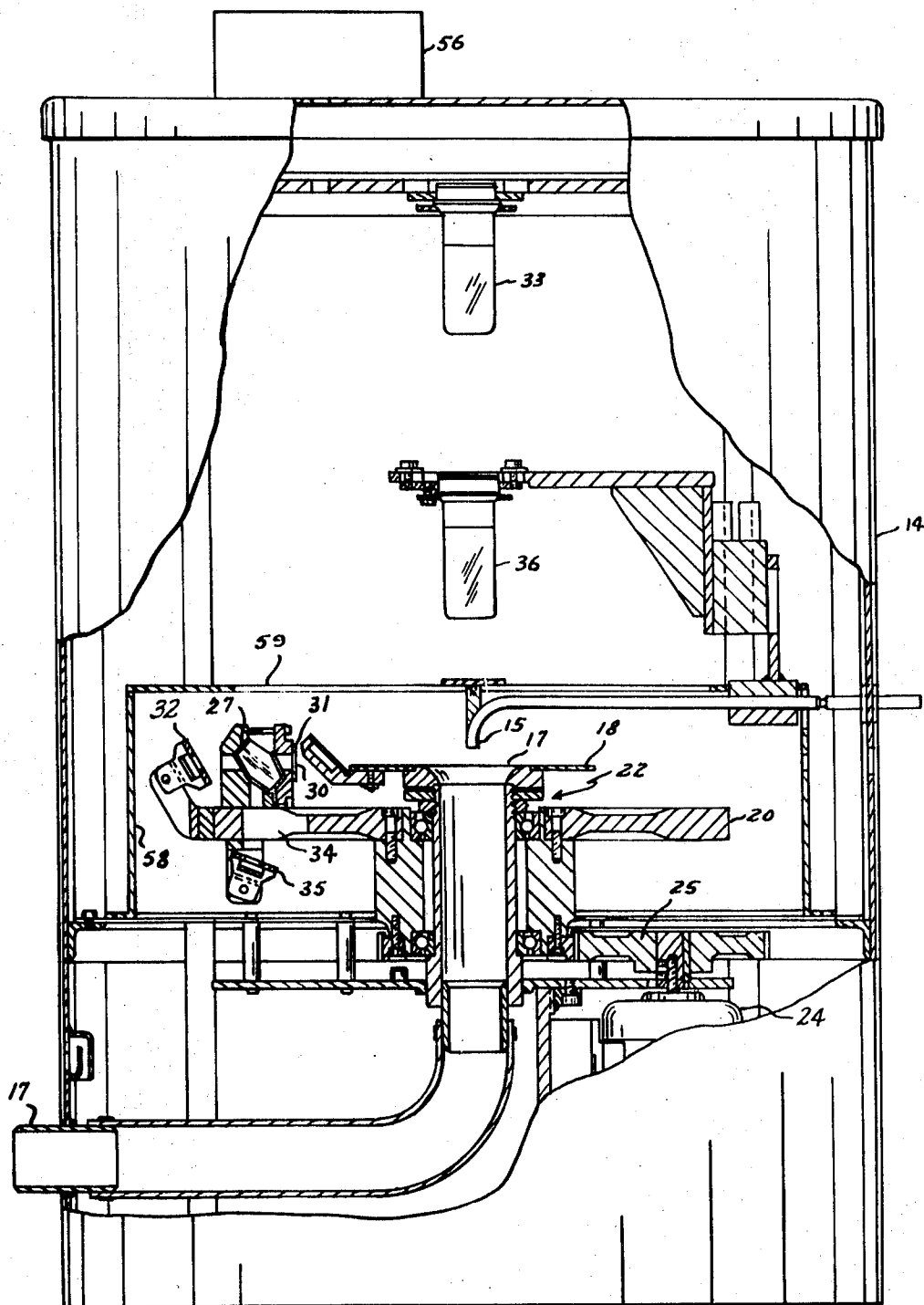


Fig. 2

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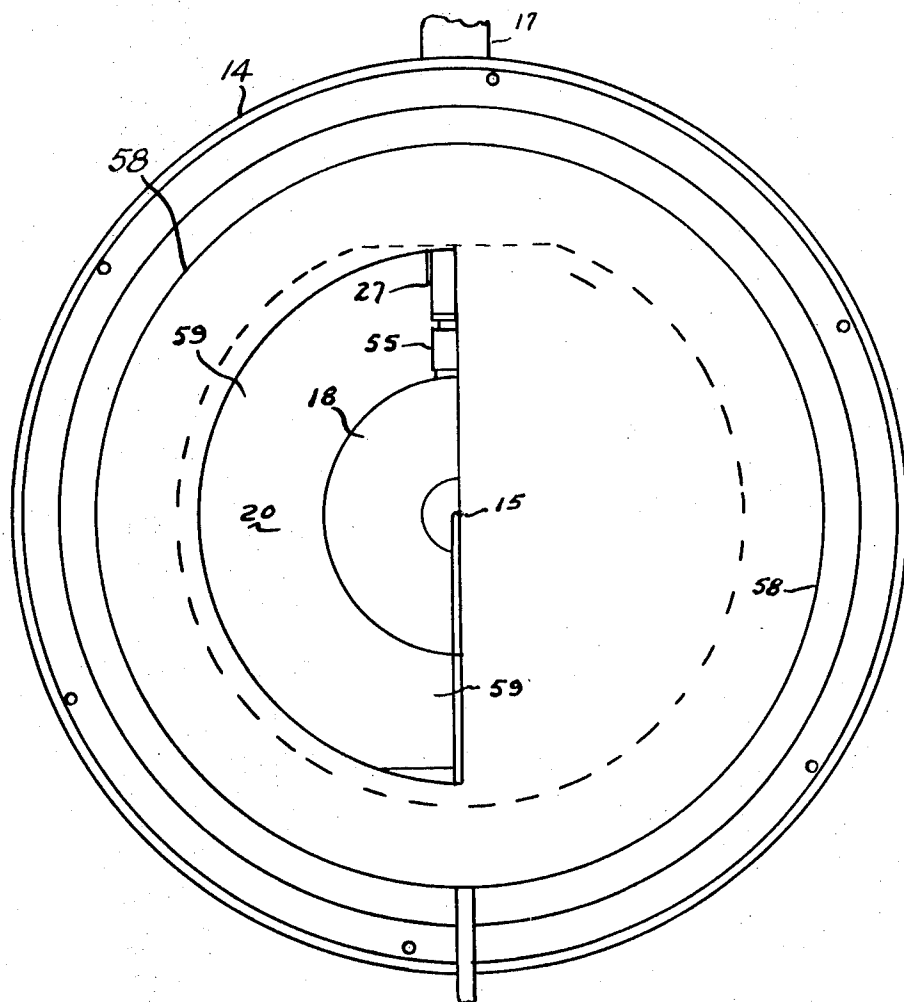


Fig 3

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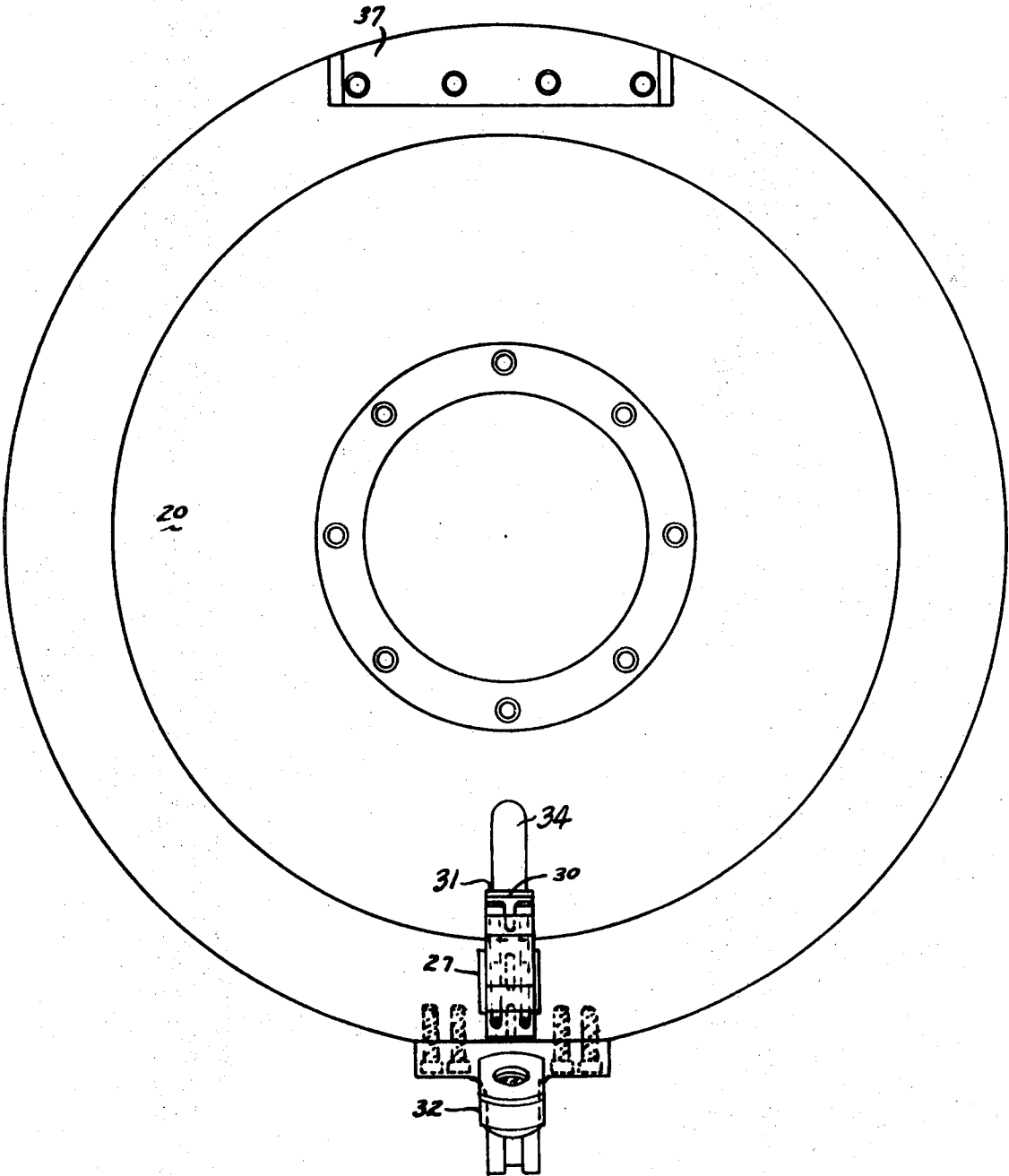


Fig 4

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SCANNING SCATTERED LIGHT PHOTOMETER

BACKGROUND OF THE INVENTION

In the study of aerosols, colloidal dispersions, and other particulate suspensions the particle size distribution is obtained by the polarization ratio method as is described in the article "Aerosol Studies by Light Scattering" in *The Journal of Colloid Science*, Vol. 19, 1964, pp. 213-222.

In the prior art, data is obtained in a point-by-point system. This is very time consuming and limits the type of samples from which data may be obtained. Since data must be obtained by moving from point to point to different angular positions around the sample there is a considerable time lag between the obtaining of the initial and the final data. In samples wherein changes are occurring, such as coagulation, this time lag seriously limits the data obtainable from the sample.

SUMMARY OF THE INVENTION

According to this invention, an apparatus is provided that substantially reduces the time required to obtain data from a sample and which provides more complete data than could be obtained with prior art methods. A collimated, monochromatic unpolarized light source is positioned to impinge a beam of light on an aerosol sample in a space between an entrance nozzle and a vacuum exhaust outlet. The sample flows through the center of a hub around which a scanner rotates. A polarizing prism and two mirrors are mounted on the scanner. The mirrors direct the two polarized components of the light scattered by the sample to two photomultipliers positioned above the center of the scanner. The outputs of the photomultipliers are fed to an analog divider circuit and signal averaging circuit with the output of the signal averaging circuit being applied to a display device and a recorder. A sync signal for the signal averager may be provided if needed.

IN THE DRAWING

FIG. 1 is a schematic diagram partially in block form of a scanning scattered light photometer system according to the invention;

FIG. 2 is a partially cutaway front elevation of the scanning apparatus for the device of FIG. 1;

FIG. 3 is a sectional view of the device of FIG. 2 along the line 3-3; and

FIG. 4 is a top view of the rotor assembly for the device of FIG. 2.

DETAILED DESCRIPTION OF THE INVENTION

Reference is now made to FIG. 1 of the drawing which shows a scattered light photometric system including a scanning apparatus 12 shown in greater detail in FIGS. 2-4. The scanning apparatus 12 includes a chamber 14. A sample to be tested is supplied to a nozzle 15 in the center of chamber 14 from sample supply 16. The flow leaving nozzle 15 is directed toward an exhaust outlet 17 which leads to a vacuum source, not shown. A beam of collimated, monochromatic unpolarized light is directed toward the sample from a light source 19. The light is scattered by the particles of the sample leaving the nozzle 15. A rotor 20 has a hub 22 surrounding the exhaust outlet 17. The rotor 20 is driven by a motor 24 through a gear train 25. A polarizing beamsplitter 27 is mounted on the rotor 20. As the scanner is rotated, the light scattered at any particular angle is received by a slot 30 in a mask 31 positioned in front of the polarizing beamsplitter 27. Light polarized in the plane of rotation of the polarizer on the scanner is reflected by a precision front surface mirror 32 toward photomultiplier 33. Light polarized in the plane perpendicular to the plane of rotation is reflected by a precision front surface mirror 35 through a slot 34 in rotor 20 toward a photomultiplier 36. A counterbalance 37 for the beamsplitter 27 and mirrors 32 and 35 is provided on rotor 20. A

beamsplitter 27 may be a Spectra Physics Model 515 polarizing beamsplitter and the mirrors 32 and 35 may be Spectra Physics Model 576-41 front surface mirrors. The light source 19 may be a Spectra Physics Model 132 1-milliwatt helium-neon laser.

The output of photomultipliers 33 and 36 are passed through preamplifiers 40 and 42 and then to an analog divider 46 which provides an output A/B. The analog divider 46 may be, for example, a Princeton Applied Research Co. Model 230. The output of the analog divider 46 is then supplied to a signal averaging circuit 48 which may be, for example, the Princeton Applied Research Co. Model TDH-9 Waveform Educator. The signal averaging circuit divides the signal waveform into 100 segments continuously samples and averages each segment and provides in the output a smooth waveform based on these averages which is substantially free of noise. A device which performs the function of both the analog divider 46 and the signal averaging circuit 48 is the Fabri-Tek 1070 signal averaging computer. The output of the signal averaging circuit 48 is applied to either a recorder such as an oscillograph 51 or to a display device such as an oscilloscope 52.

The output of the photomultipliers 33 and 36 may be used in other circuits than that described, for example, they could be supplied to a circuit to provide an output $A-B/A+B$ or other outputs as may be desired.

When a synchronizing signal is needed such as in averaging corresponding parts of a signal, as in signal averaging circuit 48, this signal may be obtained by providing a stationary mirror 55 mounted on flange 18 on outlet 17 which directs unscattered light to a photoconductor 56. This light is blocked from the mirror and photoconductor whenever the polarizer 47 and mirrors 32 and 35 pass the side of the chamber 14 adjacent the light source 19 and thus provides a synchronizing pulse to the averaging circuit 48. Since light scattered by the sample is the same on both sides of the beam, an output is needed for only 180° of the rotation of the rotor. A shield 58 having a semicircular opening 59 blocks light from mirrors 32 and 35 to photomultipliers 33 and 36 during half of the rotation. This could also be accomplished electronically by means of a gate circuit which provides a gate pulse for the desired period to be observed by the waveform averages in response to the output from the photoconductor 56. Power is supplied to the various devices from a power supply 60.

There is thus provided a scanning scattered light photometer system which provides more complete data and substantially reduces the time required to obtain data.

I claim:

1. A device for providing an output signal proportional to the two polarized components of light scattered by a flowing aerosol for all angular positions in a predetermined 180° region around the flowing aerosol comprising: means for providing a sample flow; means for directing a beam of collimated monochromatic unpolarized light toward said flow; a beamsplitter polarizer; an apertured mask between said beamsplitter polarizer and said sample flow; means for moving said mask and said polarizer in a circular path around said sample flow; a first photomultiplier tube; means for directing a first polarized component of light scattered by the flowing aerosol, in the plane of said circular path, toward said first photomultiplier tube; a second photomultiplier scattered by the flowing aerosol, perpendicular to the plane of said circular path, toward said second photomultiplier tube; means responsive to the output of said photomultipliers for providing an output signal proportional to the output of the first photomultiplier tube and the second photomultiplier tube.

2. The device as recited in claim 1 wherein said means for providing an output signal includes an analog divider means for providing a signal proportional to the ratio of the output of said first photomultiplier and the output of said second photomultiplier; a signal averaging circuit connected to the output of said analog divider means; means for supplying a signal to said signal averaging circuit for synchronizing the

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signal averaging circuit with the rotation of the polarizer in said circular path; an output circuit connected to said signal averaging circuit.

3. The device as recited in claim 2 wherein said output circuit includes a recorder.

4. The device as recited in claim 2 wherein said output circuit includes a visual display device.

5. The device as recited in claim 2 wherein said means for synchronizing the signal averaging circuit with the rotation of

the polarizer includes a photovoltaic cell; a stationary mirror positioned in line with the beam of collimated monochromatic unpolarized light; said means for moving said polarizer in a circular path being a rotor for moving the polarizer into the light beam path once during each revolution of the rotor to block light to said stationary mirror and photovoltaic cell to thereby provide a synchronizing signal for said averaging circuit.

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