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HMB004 AUTOMATIC POLARIMETER

OPERATING INSTRUCTION

Please read through these operating instruction before using

CONTENTS

I. APPLICATION

The polarimeter is a kind of instrument for measuring the optical rotation of a substance. Through measuring the optical rotation, the polarimeter can be used to analyze the sugar degree. The automatic polarimeter utilizes the photoelectric detection automatic balance principle and the results are displayed by LCD. It not only preserves the advantages of ZUZI polarimeter, but also overcomes the shortcoming of inconvenience in reading. The automatic polarimeter is characterized by its small size, high sensitivity, human error-free, easy reading, and so on. Furthermore, this instrument is also suitable to the sample of low optical rotation which is difficult to be analyzed by visual polarimeter. Therefore, it can widely be used in various fields of the organic chemical industry.

Agriculture: use in contents analyses of agricultural antibiotic, hormone, microbial agro-pharmaceuticals and agricultural products.

Medication: use in analyses of antibiotic, vitamin and glucose and in pharmacological research of Chinese medicinal herbs.

Food: use in analyses of sugar, monosodium glutamate and soy sauce, in inspection of their final products and determination of sugar content in food.

Petroleum: use in analyses of mineral oil and in control of oil ferment process.

Essence: use in analyses of essential oil.

Health: use in analyses of diabetics' urine.

II. PERFORMANCE

Measuring range: ±45° (±120°Z)

Monochromatic light source: LED (589.44nm)

Minimum sample transmittance: 1%

Accuracy: ±(0.01+ measuring value×0.05%)°

□ ±(0.03 + measuring value×0.05%)° Z

Repeatability: ≤0.002°

Minimum indicating value: 0.001° (0.01°Z)

Sample tube: 200mm, 100mm

Power supply: 220V±22V, 50Hz±1Hz

Outer size: 600mm × 320mm × 220mm

Weight (net): 30kg

RS232 interface

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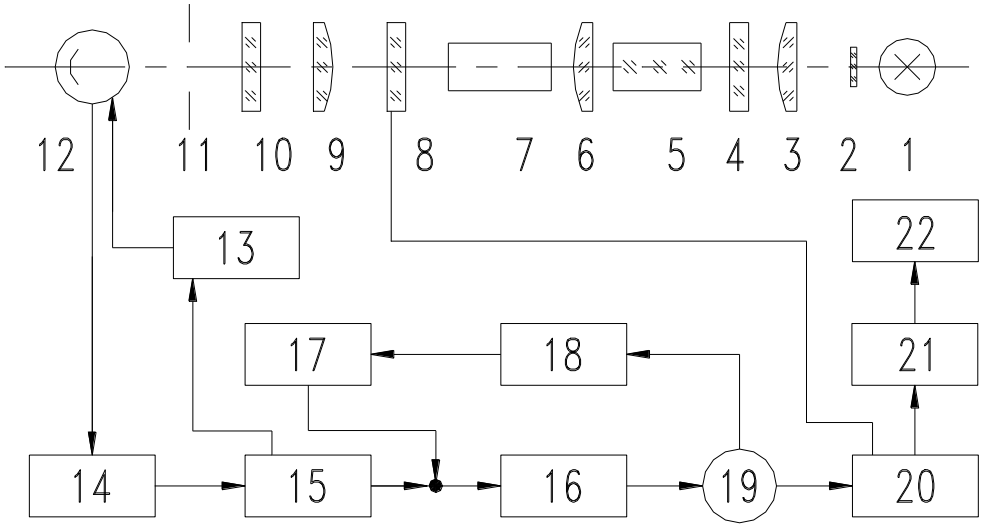
III. CONSTRUCTION AND PRINCIPLE

The polarimeter utilizes LED, a small aperture stop and a lens to make up a collimated point light source as shown in figure 1. The parallel light passes through polarizer and becomes a polarized light whose vibration direction is denoted by line OO in figure 2a. When the polarized light is passing through the Faraday modulation coil, its vibration direction will generate a β angle swing (50Hz), as shown in figure 2b. Then the polarized light passes through the analyzer and is projected onto the photomultiplier, an ac signal will be produced.

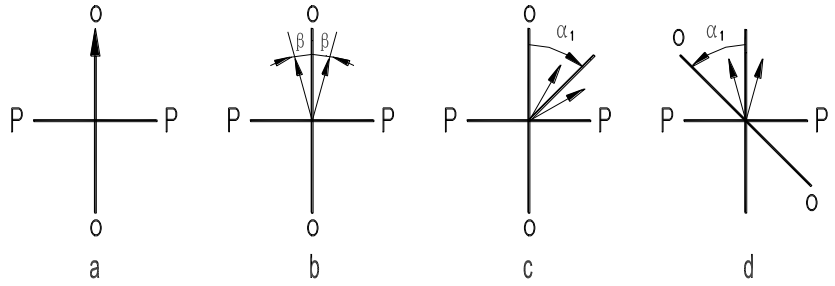
The optical zero point of the polarimeter is obtained when the polarization plane of the polarizer is perpendicular to that of the analyzer (i.e. OO$\perp$PP), and at the time $\alpha = 0$ (see figure 3). A photo-signal of 100Hz will be obtained at the optical zero point, due to the β angle swing which is generated by the Faraday coil, as shown in curve C. But in the case where samples α_1° and α_2° exist, two 50Hz signals with inverse phases are obtained, as shown in curve B' and D'. Therefore, this will enable the servomotor with an operating frequency of 50Hz to be driven. The polarizer will be turned through α angle ($\alpha = \alpha_1$, or $\alpha = \alpha_2$) by means of a worm-worm wheel. Now, the polarimeter has returned back to the optical zero point. At the frequency of 100Hz the servomotor keeps stationary and the optical rotation of the sample is indicated.



1.LED 2.Condenser 3.Lens 4.Polarizer
5.Modulator 6.Collimator 7.Sample Tube 8.Analyzer
9.Lens 10.Filter 11.Aperture 12.Detector
13. Auto H.V 14.Pre-AMP 15.FREQ-Selection 16.Power-AMP
17.Non-Linear control 18.Speed-Feedback 19.Servo Motor

20.Drive Gear 21.Coder 22.Display

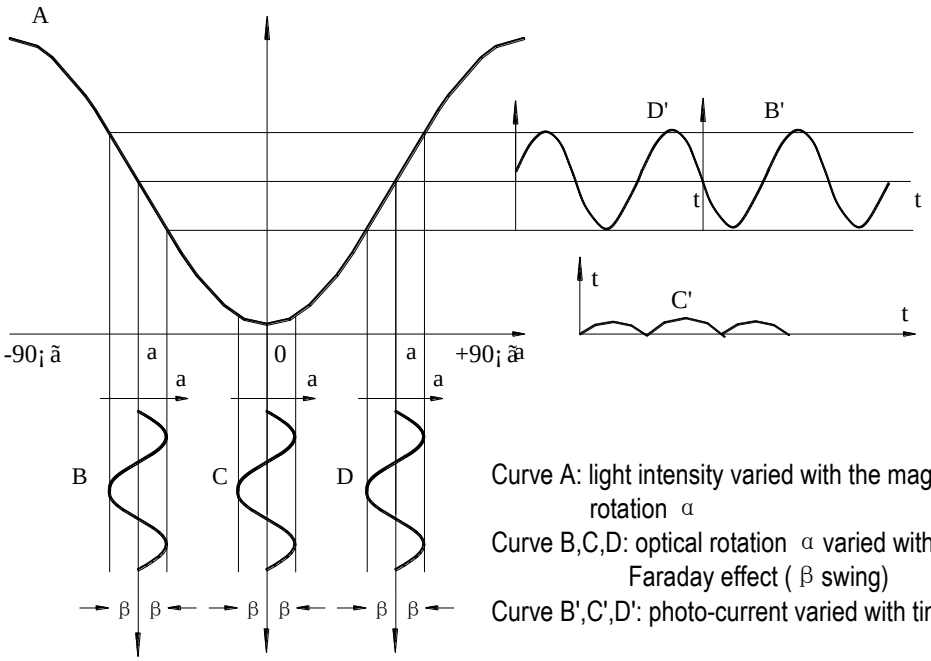
Fig.1 Block Diagram



a) polarized light generated by polarizer, polarization plane is OO.
b) polarized light after passing through the Faraday coil, the light vibration direction a swing of β angle.
c) polarized light after passing through sample, vibration direction turning through α_1.
d) polarizer turing to the opposite direction through α_1 to compensate sample optical rotation and to reach the balanced condition.

OO: polarization plane of polarizer PP: polarization plane of analyzer

Figure 2



Curve A: light intensity varied with the magnitude of optical rotation α
Curve B,C,D: optical rotation α varied with time t due to Faraday effect (β swing)
Curve B',C',D': photo-current varied with time t—photo-signal

Figure 3

IV. HOW TO USE

i. Installation

The instrument can be operated under normal illumination, temperature and moisture. Extreme heat, excess moisture and corrosive gases may cause damage to it. The instrument should be placed on a sturdy and roughly level support.

ii. Power connection

Plug one end of the power cord to the power outlet (the stabilized voltage power is better) and the other end to the power socket on the back of the instrument.

iii. Preparing the sample tube

iv. Clear

Fill the prepared sample tube with distilled water or solvent fit for the sample to be measured. Put the tube into the sample chamber, press the "Clear" button. Note that bubbles blocking the passage of light, dirt on both ends of the tube or too much tightening of the tube nuts may introduce error reading. Take measures to avoid them.

v. Measurement

Empty the sample tube. Fill it with the sample to be measured. Put the tube into the sample chamber. The instrument operates and will indicate the optical rotation of the sample, the diode "1" light.

Remark: use the sample to wash the tube (inside) three or five times before measurement.

vi. Re-M

Press the "Re-M" (repetition- measurement) button once, the diode "2" light, the instrument display the result of 2nd measurement, press the "Re-M" button again, the diode "3" light, display the result of 3rd measurement, press the "shift/1 2 3" button, shift display the values of measurement each time, press the "Average" button, display the value of average, the diode "AV" light.

vii. Temperature correction

After taking the temperature of the sample, correct the measured result by calculation.

viii. Measurement for dark-colored sample

The reproducibility will reduce when measurement is taken for samples with transmittance near 1%.

ix. RS232 interface

The instrument can use RS232 cable to connect with computer. (Parameter: Baud-Rate 9600, Date-bits 8, Stop-bit 1, Byte length 18).

x. Measurement of the sugar degree

The default of the instrument is measuring the optical rotation, if you want to measure the sugar degree, press the "Z/α" button, the diode "Z" light.

Remark: when the sample chamber has tube, press the "Z/α" button, the diode "Z" light and display "0.000", you should take the tube out the chamber and put into again, this moment the instrument just display the value of the sugar degree.

xi. Measurement of the concentration or content

Dilute the known purity standard sample or reference sample into several specimens with different concentration, based on a given ratio. Then, determine the optical rotation values of these specimens. After that, a curve of the optical rotation is plotted with the ordinate referring to the optical rotation and the abscissa to concentration. Based on the optical rotation curve, a table is to be compiled by the interpolation method. In this measurement, the optical rotation of the sample will be determined at first, followed by finding out its concentration or the contents according to the optical rotation curve.

Note that, the optical rotation curve should be plotted on the results obtained from the same instrument and the same sample tube.

xii. Measurement of the specific rotation or concentration

A solution of definite concentration should be prepared according to the pharmacopoeia regulations. Then, determine the optical rotation of the solution.

The specific rotation (α) can be calculated by following formula:

$$(\alpha) = \frac{\alpha}{LC}$$

where α is the determined optical rotation (degree)

C is the concentration of the solution (g/ml)

L is the length of the solution (dm)

From the specific rotation, the purity of the sample will be found.

Purity = actual specific rotation / theoretical specific rotation

xiii. Determination of international sugar degree

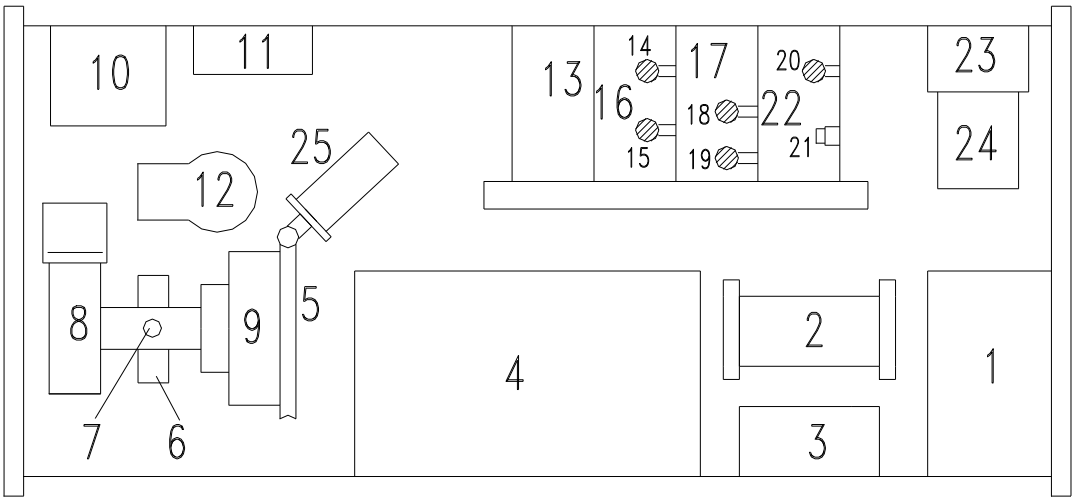
According to the regulations of ICUMSA*, a standard sugar solution (26g / 100ml) is tested in 200mm sample tubes at a temperature of

20℃, using the sodium lamp. The result is: the optical rotation of +34.616° and the sugar degree of 100°Z.

* International Commission for Uniform Methods for Sugar Analyses

V. MAINTENANCE

The polarimeter should be placed in a dry place with good ventilation and kept from corrosion. The instrument should be handled with care and vibration is not allowed.
The light source can be cleaned or changed if it is dirty or faulty.
If the instrument mechanism is operated in great friction, it is advisable to put some oil into the bevel gears, the worm gear as well as the worm through the rear door.
If the instrument is damaged or some other parts are in failure, please ask professional to check or contact with our repair department.



1. LED 2.Faraday Coil 3.Digital Display 4.Sample Chamber
5.Worm Gear 6.Correcting Slide 7. Holding Screw 8.Photo-Detector
9.Pre-A.M.P 10.Supply Transformer 11.Power Socket
12.Coder and Motor 13.Digital Board 14.Phase Potentiometer
15.Non-Linear Potentiometer 16.Freq-Selection Board 17.Power AMP. Board
18.Gain Potentiometer 19.Damp Potentiometer 20.H.V. Potentiometer
21.Current adjuster of sodium lamp 22.Light Source & H.V Board
23.Fan 24.Heat Sink 25.Servo motor

Fig.4 Inside View

The instrument was calibrated before leaving our factory. If test values deviate from the correct ones, the instrument should be regulated with our standard quartz test tube (available to customer's order) or with the sample whose Optical Rotation is accurately known.
Fig4 is the inside view of the instrument after taking off its top cover Undo the holding screw shown in Fig.4, correct the test value by slightly moving the correcting slide until the standard value is obtained. Then tighten the holding screw. If the procedure above doesn't succeed somehow, send the instrument back to our factory for a thorough inspection.

VI. COMMON BREAKDOWN AND HANDING

Breakdown Appearance	ANALYSES FOR REASON	Handling method
After turning on the power source (AC), the lamp doesn't light up.	The power switch, LED or the fuse (3.15A) is break.	Change
After turning on the power source (DC), the lamp doesn't light up.	The LED is break. The power board is break.	Change Send to our repair department.
The instrument can't balance automatically.	The light can't go through the sample chamber. The lamp is not lit up completely. The high voltage or servosystem has problem.	Clear sundries. Waiting. Send to our repair department.
No display or display not completely	Display circuit has problem.	Send to our repair department.
The sound is too loud.	Mechanical friction	Open the rear door, moving parts oiling.
Repeatability is bad and value is deviating.	The lamp is aging. The optical system has dust.	Change Send to our repair department.