Optical Instruments

Universal Interferometer

Ealing Electro-Optics' Universal Interferometer consists of a combination of Michelson, Twyman-Green and Fabry-Perot Interferometers, assembled on a common base from standard parts. Each of the three configurations can be assembled easily and inexpensively, and conversion from one technique to another is straightforward.

The Universal Interferometer may be obtained complete or as sub-assemblies for specific applications, in four forms;

- as the complete Universal Interferometer
- as one of three interferometer types
- as Units A, B, C or D, the building blocks of the system
- as conversion sets, from one technique to another

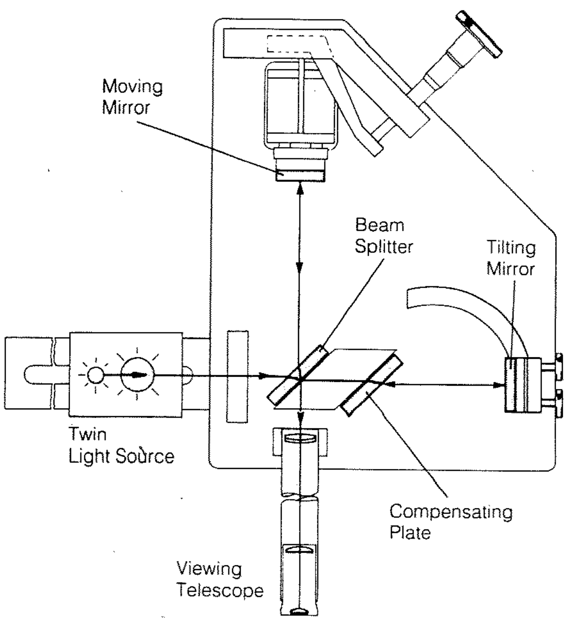
The three types of interferometer are assembled from combinations of the units identified as A, B, C and D, described in greater detail on Page J-7. They can also be ordered individually or as conversion sets for upgrading or replacement purposes. An instruction manual and a set of experimental notes are supplied with each instrument.

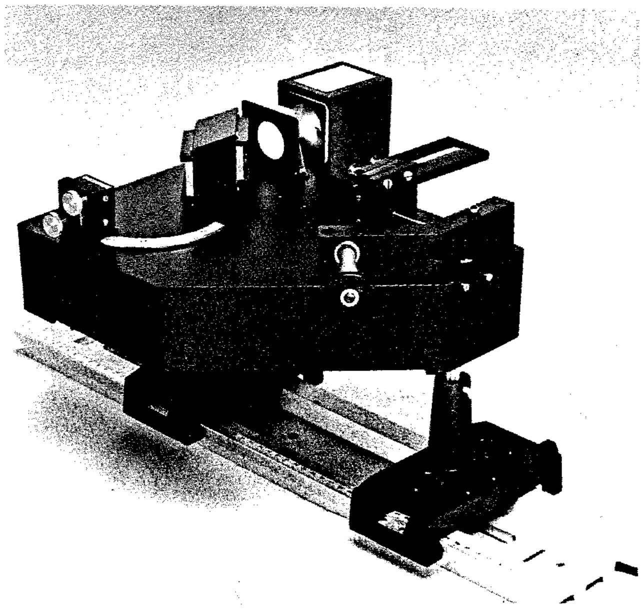
Universal Interferometer

The Universal Interferometer comprises the units A, B, C and D. These provide a complete set of parts necessary for the demonstration of Michelson, Twyman-Green and Fabry-Perot techniques, excluding the light source – see Page J-9. The applications for each type of interferometer are described under their separate headings below, and a physical description and specification of each of the four units begins on Page J-7.

Universal Interferometer 25-9093

Ray path through Michelson Interferometer ▼





Universal Interferometer configured for Michelson Technique ▲

Michelson Interferometer

The Michelson Interferometer includes Unit A, the Universal Interferometer Base, plus Unit B, Michelson Optics.

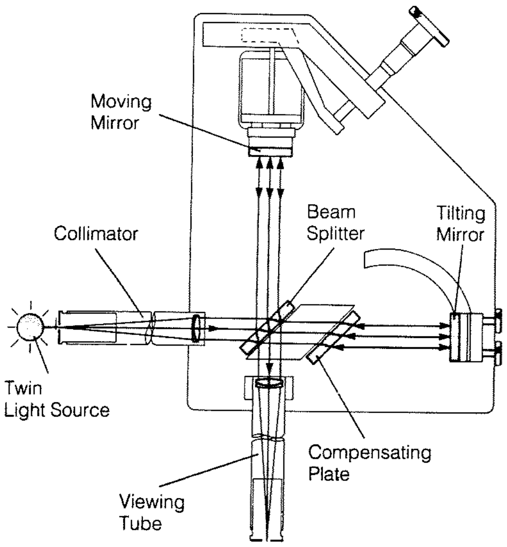
This instrument is used to detect small changes in optical path length with great precision. It employs a beamsplitter mirror to divide a beam of light into two parts that are recombined at the same surface to produce interference effects.

The Michelson Interferometer can be used to demonstrate:

- The formation of circular and localized monochromatic and white light fringes
- Accurate comparison of wavelengths
- Establishment of zero path difference
- Measurement of refractive indices of gases and transparent solids
- Accurate determination of inhomogeneities and surface variations of transparent solids
- Accurate measurement of small changes in length

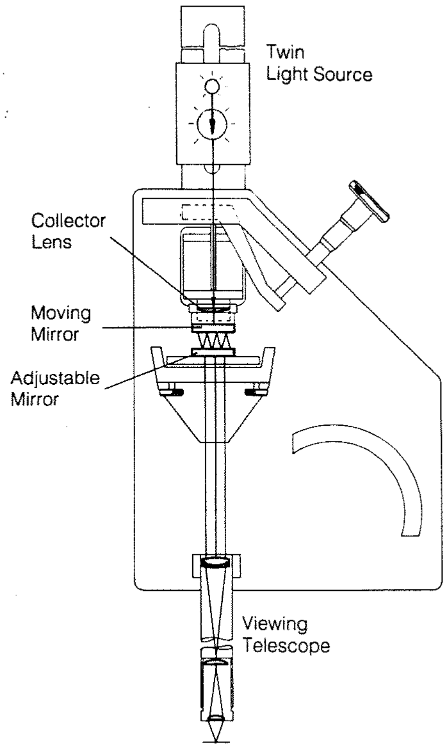
Michelson Interferometer 25-9069

Optical Instruments
Universal Interferometer



Ray path through Twyman-Green Interferometer ▲

Ray path through Fabry-Perot Interferometer ▼



Twyman-Green Interferometer

This instrument includes Unit A, the Universal Interferometer Base; Unit B, Michelson Optics, plus Unit D, the Twyman-Green Optics.

The Twyman-Green Interferometer is a development of the Michelson, in which a collimator in the beam produces a plane wavefront. It is primarily used for:

- Accurate determination of dispersion of prisms
- Quantitative assessment of inhomogeneities and surface variations in windows and prisms

Twyman-Green Interferometer 25-9085

Fabry-Perot Interferometer

The Fabry-Perot Interferometer is made up of Unit A, the Universal Interferometer Base, plus Unit C, Fabry-Perot Optics.

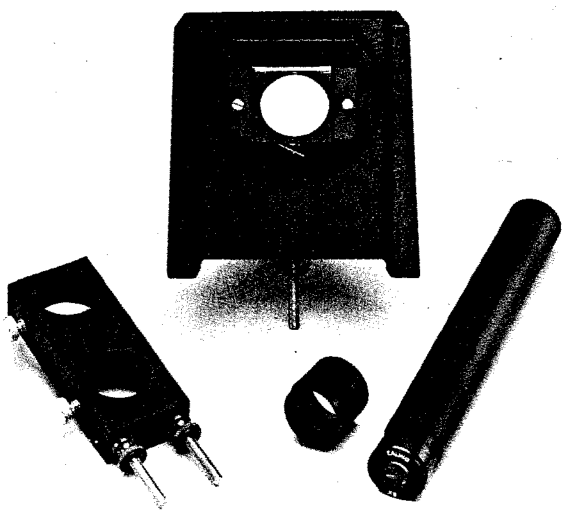
This instrument is used for resolving spectral lines only a few tenths of a nanometre apart. It produces bright, circular fringes of high resolution on a dark field by means of multiple reflections between two parallel, partially-transmissive mirrors.

The Fabry-Perot Interferometer can be used to demonstrate:

- Wavelength changes when a gas discharge is subjected to a magnetic field
- Zeeman splitting in a magnetic field

Fabry-Perot Interferometer 25-9150

Unit C, Fabry-Perot Optics ▼



UNIVERSAL INTERFEROMETER COMPONENTS

The major units from which all three interferometers are assembled are identified as Units A, B, C and D. If the Universal Interferometer is ordered in any of the configurations described above, the appropriate components will be supplied. They are listed here separately for purchase as additions or replacements only.

Unit A Universal Interferometer Base

Unit A consists of a base plus moving mirror assembly, and is required for all three interferometer techniques.

The base is a rigid aluminium casting, stiffened by webs around the edge and ribbing under the essential optical mounting points. For horizontal viewing, it stands on the laboratory bench top. To incline the instrument for easier viewing, two 13.7mm diameter legs are supplied which screw into sockets in the base.

Two further sockets in the base are on the meridian of the viewing axis. These permit the Interferometer to be mounted on Ealing Electro-Optics' benches and optical tables, as described in Sections G and H, using the pin mounts shown in Section C.

A quarter-circle track is provided on the top of the base, along which a mirror can be moved in the Twyman-Green application.

The 6mm thick, front-surface mirror is made of borosilicate crown glass, free from blemishes and finely annealed. It is aluminium coated and protected with a 1/2 wavelength coat of silicon oxide. The face is flat to 1/4 wavelength of mercury green light over the working aperture.

This mirror may be traversed 5mm along the viewing axis to establish the correct path length conditions. Movement is by a micrometer head working through a pivoted beam against a parallel, backlash-free, spring action. The micrometer has 25mm of movement and reads to 0.01mm. Since the beam provides a 5:1 reduction, the micrometer measures motion of the mirror to 0.002mm

Universal Interferometer Base 25-8905

SPECIFICATION – MIRROR

Dimensions:	32 x 32mm
Clear aperture:	28mm dia.
Transmission:	2%
Reflectance:	85%

Unit B Michelson Optics

Unit B is required for both the Michelson and Twyman-Green Interferometers. It consists of an adjustable mirror, a beam-splitter/compensating plate assembly and a diffusion screen.

The adjustable mirror, which has a similar specification to the mirror in Unit A above, slots into the quarter-circle track on the base unit. Its mount has two tilt adjustment screws. A metal pointer for alignment purposes is included in Unit B.

Michelson Optics 25-9127

SPECIFICATION – BEAMSPLITTER

Dimensions:	50 x 38mm
Material:	Borosilicate crown glass, coated
Flatness:	$\lambda/10$
Transmission:	30%
Reflectance:	30%

SPECIFICATION – COMPENSATING PLATE

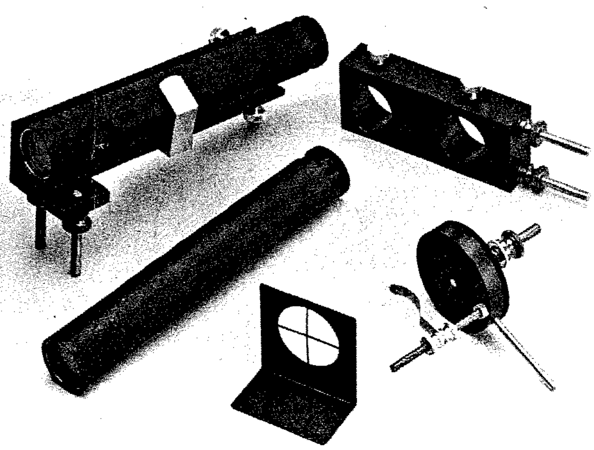
Dimensions:	50 x 38mm
Material:	Borosilicate crown glass,
Flatness:	$\lambda/4$, both surfaces

Optical Instruments

Universal Interferometer

Universal Interferometer Accessories ▲

25-9119 Michelson to Twyman-Green Conversion Set ▼



Unit C Fabry-Perot Optics

Unit C is required for demonstration of the Fabry-Perot technique. It consists of an adjustable mirror, telescope and collector lens plus a mounting bracket.

The mirror is identical to the moving mirror supplied in Unit A. Transmission is 2% and reflection 85%, giving very sharp fringes. Parallel adjustment is by means of two tilt adjustment knobs. Because the optical axis is higher than that used for the Michelson interferometer, the Michelson optics may be left in place during Fabry-Perot studies.

The telescope and collector lens, and the mounting bracket form part of the Fabry-Perot interferometer. These items can also be ordered separately, and are described on Page J-9.

Fabry-Perot Optics	25-9101

Unit D Twyman-Green Optics

Unit D is required for Twyman-Green techniques and can only be used in conjunction with Unit B, the Michelson Optics. It consists of a set of additional elements which convert the Michelson Interferometer for Twyman-Green studies. These are a collimator and viewing tube with supporting bracket, prism table, prism and crossline.

The collimator has a 150mm achromatic lens and a 3mm diameter entrance pupil. Alignment in two axes is provided by milled head screws.

The viewing tube is similar to the collimator but has a 6mm diameter exit pupil which is used for viewing. It is supplied mounted on a bracket which is also listed separately opposite.

The prism table is 45mm diameter and holds prisms up to 40mm high with an adjustable clamp. A horizontal steel rod is fitted to the side of the holder for rotating the prism. Levelling adjustment is by two small keys. The equilateral prism is of crown glass with optically worked faces 25mm x 25mm. Refractive index is 1.517.

The metal crossline is mounted on a bracket which is placed in front of the mirror for alignment purposes.

Twyman-Green Optics	25-9119

Conversion Sets

These sets contain the parts necessary to convert from one interferometric technique to another.

Michelson to Fabry-Perot	25-9101
Michelson to Twyman-Green	25-9119
Fabry-Perot to Michelson	25-9127
Fabry-Perot to Twyman-Green	25-9135
Twyman-Green to Fabry-Perot	25-9143

Optical Instruments

Universal Interferometer

UNIVERSAL INTERFEROMETER ACCESSORIES

These accessories are used for the demonstration of specific interferometric techniques. All accessories may be purchased separately and, where shown in the table, they are included as standard with the Universal Interferometer and the three individual interferometers.

Accessory	Universal	Michelson	Twyman-Green	Fabry-Perot
Light Source	o	o	o	o
Telescope & Collector Lens	•	∆		•
Bracket for Telescope & Viewing Tube	•	∆	•	•
Gas Cell & Compensator		∆		
Accessory Case	∆	∆	∆	∆

Key:
- • Included with interferometer
- o Essential, obtained separately
- ∆ May be used with, not included

Universal Interferometer Light Source and Power Supply

The light source recommended for use with these interferometers is similar to the 25-8723 Twin Light Source shown in Section D, Light Sources, but includes a bracket which attaches directly to the side of the interferometer base at a suitable height for each application. A slot in the bracket enables the illumination intensity to be altered by moving the lamp. It also accommodates the Twyman-Green collimator.

The light source consists of a small, incandescent lamp placed behind a mercury vapour lamp, with a glass shield to protect the user's eyes from UV radiation. The first lamp is a 4 volt, low pressure, mercury vapour type, with short-wave emission to allow maximum displacement of the path lengths without loss of fringe contrast. The second lamp has a tungsten filament to provide white light, and is rated at 6 volts, 0.3 amp. A green glass filter is supplied and provides monochromatic light from the mercury lamp when required. The lamps can be operated either independently or together.

A Power Supply is available for use with the Light Source, fitted with a change-over switch for 115V or 230V operation.

Universal Interferometer Twin Light Source	25-9010
Spare Mercury Vapour Lamp	25-8616
Spare Tungsten Lamp	25-8624
Twin Light Source Power Supply	25-9036

Telescope and Collector Lens

This telescope has a magnification of x6. It is supplied with the 25-9150 Fabry-Perot Interferometer and the 25-9101 Fabry-Perot Optics, and is also useful for the Michelson technique. The telescope is mounted on the 25-8970 bracket described below.

The telescope is supplied with a separate collector lens which is used to provide maximum light concentration. The collector lens is specifically intended for Fabry-Perot use and fits into the aperture on the back of the mirror of the base unit.

Telescope and Collector Lens 25-9002

Bracket for Telescope and Viewing Tube

This bracket is used to hold the Universal Interferometer Telescope shown above, or the viewing tube supplied with the Twyman-Green Optics. It features two mounting holes, the upper one on the axis of the Fabry-Perot assembly and the lower one for the Michelson or Twyman-Green technique. In addition to the interferometers shown in the table, it is also supplied with the 25-9101 Fabry-Perot Optics.

Bracket for Telescope and Viewing Tube 25-8970

Gas Cell and Compensator

The Gas Cell and Compensator assembly is used with the Michelson Interferometer, to measure minute changes in gas density. It can also be used as a sensitive manometer.

The unit has a chamber of circular section with sturdy glass end windows. The path length is 50mm. Three hose fittings are also supplied for attachment of a vacuum pump, needle valve, manometer and/or gas source.

Gas Cell and Compensator 25-8541

Universal Interferometer and Accessory Case

This solid mahogany storage case contains a shelf and drawer which will hold the Universal Interferometer, the Twin Light Source with Bracket and other standard accessories.

Universal Interferometer and Accessory Case 25-9051

INTERFEROMETERS

INSTRUCTION MANUAL

INTRODUCTION

The Beck interferometer enables three of the better-known methods, Michelson, Fabry-Perot and Twyman Green, to be employed by fitting standard units to the same base. This handbook describes how the units are fitted and adjustments made to obtain the various interference fringes. It deals with the purely functional aspects of the instrument. A further publication describes various experiments and their related formulae.

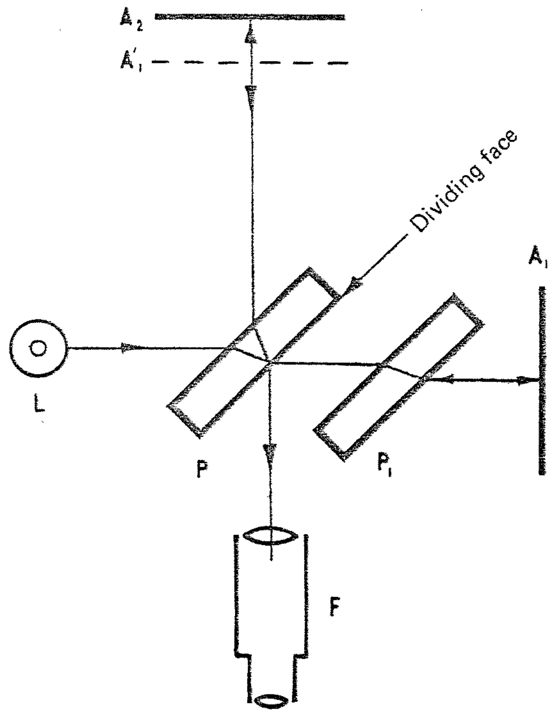


Fig. 1

THE MICHELSON INTERFEROMETER

employs two coherent reflected beams. Light from the light source L (Fig. 1) is incident at an angle of 45° to the parallel plate P at the surface of which it is divided into two beams which fall normally on the mirrors A_1 and A_2. The returned beams re-unite at the same surface and can be viewed direct by eye or by means of telescope F. The light reflected by A_1 passes through the plate P three times while that from A_2 has only a single passage. The plate P_1 of which is identical thickness and accurately parallel to P is placed in this path for compensation. When the mirrors A_1 and A_2 are perpendicular, and A_1 is slightly closer than A_2 the image of A_1 will fall in front of A_2 at a position A_1^1 and a series of interference rings will be seen. When the mirrors are equidistant and perpendicular no interference will take place and the field will be uniform. When the surfaces A_2 and A_1 are not truly parallel and their distance apart is very small, a series of fringes approximating to straight lines will be seen, becoming brighter as the distance apart is decreased.

THE FABRY-PEROT INTERFEROMETER

employs multiple reflections between two parallel separated partial mirror surfaces P_1 and P_2 (Fig. 2) placed in front of a lens L with focal plane at F. Light from each point of an extended light source will be transmitted and reflected at each plate, the amplitude being proportional to the square root of the fraction of light intensity transmitted and reflected at each surface. The light reflected back from P_2 will again be reflected by P_1 and the resulting multiple reflections produce a distinctive interference pattern of bright circular rings on a dark field.

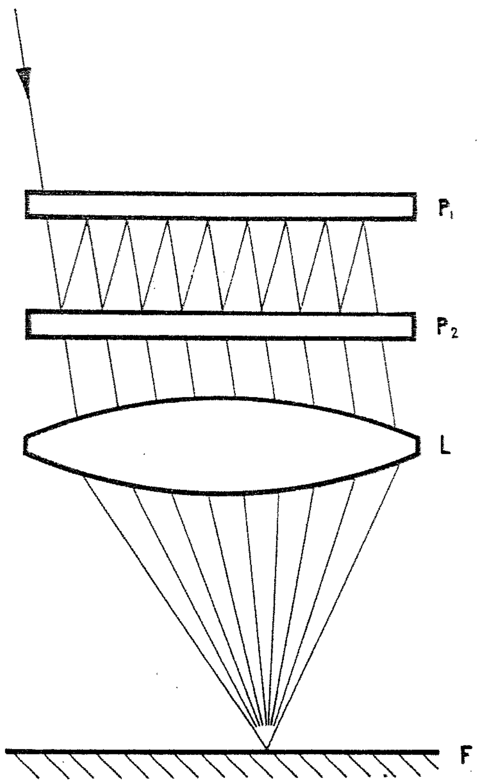


Fig 2

THE TWYMAN-GREEN INTERFEROMETER

divides a plane wavefront, as given from a point source at the focal plane of a corrected objective lens, by a semi-reflecting plate. On re-uniting, the two beams are brought to focus by a second objective, at the focal point of which the eye is placed.

The interferometer base is common to all the techniques and it is possible to purchase the further units required without the necessity of returning it to the manufacturer.

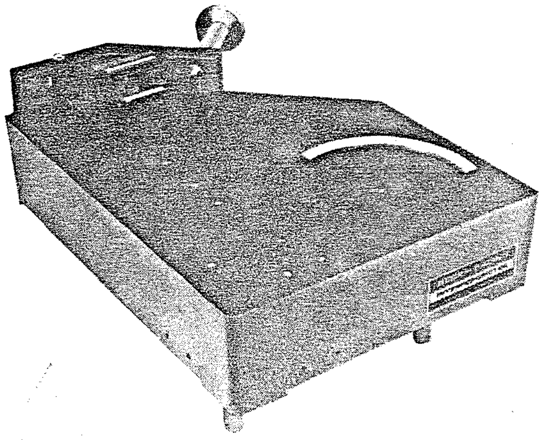
COMPONENTS

UNIT A.

The base can be mounted in three positions, each being suitable for the different modes.

1. Flat on a table-top, for a horizontal viewing.
2. Inclined on a table-top. The instrument is supplied with two legs of equal length. The legs must be screwed tightly into sockets underneath the base near the viewing position. Inclined viewing is generally more comfortable when the interferometer is used at normal table heights.
3. On an optical bench. The interferometer is readily adapted to the Ealing/Beck triangular and lathe bed type optical benches. Two of the sockets underneath the base which accept legs are in the meridian of the viewing axis. The legs serve as pins which locate into optical bench accessory carriers and ensure that the viewing axis of the interferometer coincides with the axis of the optical bench.

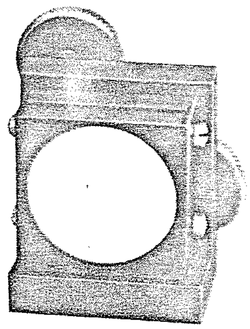
The mirror and carrier which are incorporated in the base can be traversed along the viewing axis for path length control by means of a micrometer actuating a pivoted beam coupled to the carrier. The beam provides a 5:1 reduction. The micrometer has 25 mm. movement and vernier graduations for reading ·01 mm. It can be removed from its mounting to allow alternative devices to be fitted for further applications of the instrument. The mirror is attached to the carrier by two large milled-head screws with the aluminium coated face towards the viewing position. In the Fabry-Perot version the mirror is arranged to project above the carrier. For Michelson and Twyman Green it is arranged in the low position (i.e. below the milled-head screws). The two coloured distance pieces between the mirror and its mounting are removed when the Twyman Green interferometer is employed for testing prisms.



UNIT A

UNIT B.

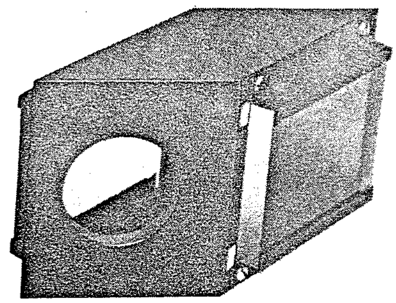
A surface aluminised mirror with two tilt controls. It is employed on the metal quadrant which is permanently mounted on the base. The three bolts holding the quadrant can be unloosened from underneath, the mirror is fitted to it and the bolts tightened, when the mirror will be securely held. For Michelson use the mirror is placed opposite the light source, i.e. perpendicular to mirror unit A (Fig. 3). For Twyman Green interferometry with a refracting prism it is rotated to a position about half way along the quadrant by first of all loosening the screws of the latter unit (Fig. 12). When examining a right angle prism by total reflection, the mirror is placed at the other end of the segment, i.e. parallel to mirror unit A. This unit does not form part of the Fabry-Perot assembly.



UNIT B

UNIT C.

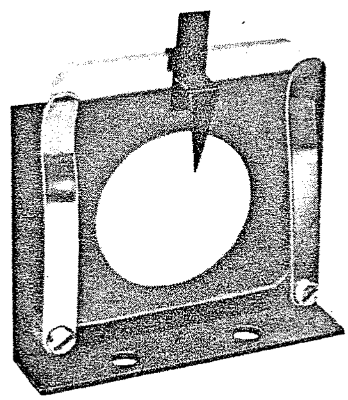
Beam splitter with compensating plate employed in both the Michelson and Twyman Green. It is attached by three bolts which are passed through the relative holes in the base and secured firmly by nuts and washers beneath (Fig. 3).



UNIT C

UNIT D.

Comprises two clips for retaining a diffusing screen or filter and is intended for use with the light source for Michelson and Twyman Green interferometry. Pass the two bolts through the unit and into the base and fix firmly by nuts and washers underneath (Fig. 3).

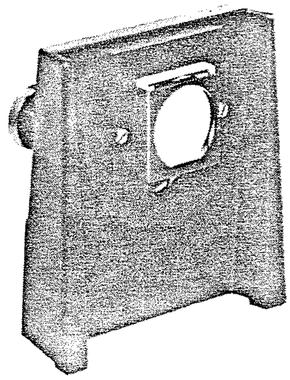


UNIT D

UNIT E.

The Fabry-Perot etalon. This unit consists of a mirror on a bracket incorporating tilting controls (Fig. 8).

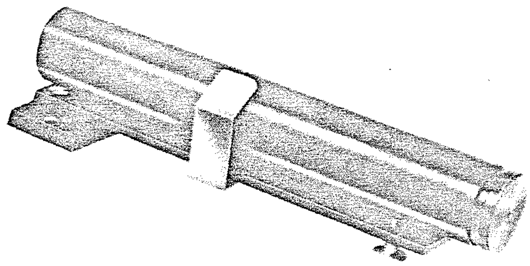
Before installation, adjust the mirror by means of the controls until it is approximately vertical to the base of the unit. The carrier of the mirror of unit A must then be traversed backwards to its fullest extent by means of the pathlength control. Pass the bolt on the unit through the correct hole, ensuring that the aluminium coated face of the mirror is towards unit A. Rotate the unit slightly until the two mirrors are approximately parallel and clamp tightly by means of a nut underneath the base.



UNIT E

UNIT F.

Collimator for Twyman Green use. It is held in a cradle by a spring so that it can be readily removed and replaced. The cradle is attached to the base by the two bolts in position indicated in Fig. 12, and secured by nuts. The collimator is placed in position so that the objective lens is towards the beam splitter. The cradle has two milled headed screws near to the pinhole end to align the collimator, one in the horizontal plane and the other in the vertical plane.



UNIT F

UNIT G.

Viewing tube for Twyman Green use. It is held in the lower recess of bracket, unit H, into which it is inserted with the objective lens facing the beam splitter (Fig. 12).

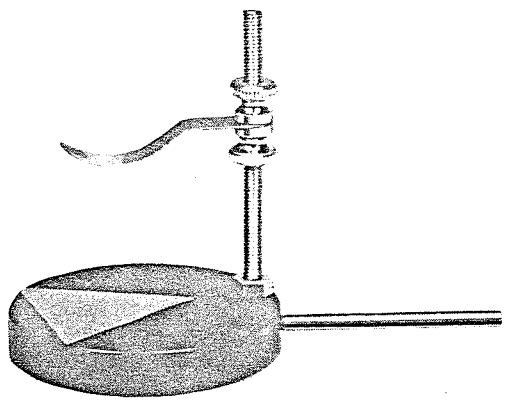
UNIT H.

The bracket is attached to the base by the two screws into the holes indicated in Figs. 8 and 12 and secured by nuts from underneath.

The upper recess accommodates the telescope in the Fabry-Perot assembly and the lower recess, the telescope when used for the Michelson and the observing tube of the Twyman Green.

UNIT I.

The levelling table accommodates the prism under test by the Twyman Green method. It has a one hole fixing through the base, with a coiled spring inserted between the underneath of the base and the nut. The nut should be tightened until the spring is under slight tension. A slightly raised triangular facing on the upper surface of the table indicates the correct position of the prism. The vertical threaded pillar has two nuts between which a spring clip is held. By screwing the nuts up and down the position of the spring clip can be adjusted to hold any prism up to a vertical size of 40 mm. This pillar projects slightly through the base and in conjunction with two small Unbrako screws, provides a kinematic seating upon which the table can be levelled. A key to operate the screws is provided. Should it be difficult to level the table perfectly, the nut controlling the spring underneath will require loosening. The table is fitted with a horizontal arm for rotation.



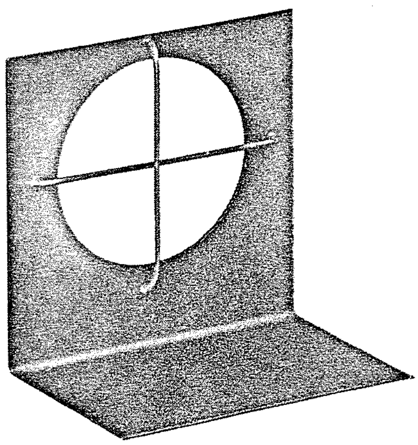
UNIT I

UNIT J.

Refracting prism of suitable size for use on the levelling table.

UNIT K.

Metal crossline on a bracket. This is free standing and is placed in front of mirror A in the Twyman Green application to test for autostigmatism. (Fig. 12).

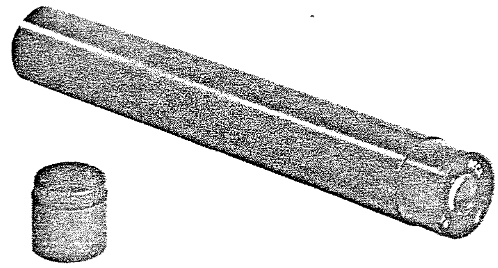


UNIT K

UNIT L.

The telescope has a magnification of $\times 6$. The position of the ocular in the tube can be adjusted to infinity. It forms a component of the Fabry-Perot unit and can also be supplied as an extra for use on the Michelson.

The collector lens which is specifically intended for the Fabry-Perot fits into the back of mirror A to increase the illumination (Fig. 8).



UNIT L

UNIT M.

The gas cell is firmly screwed into position using the holes indicated, in viewing axis 1 of the interferometer (Fig. 3).

It has three inlets which are connected as follows:—

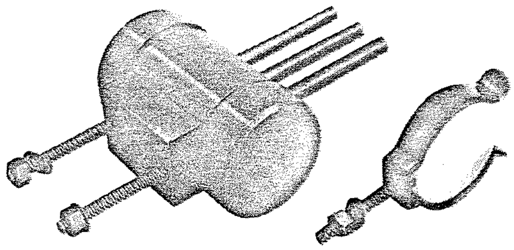
1—gas cylinder via needle valve

2—mercury manometer

3—vacuum pump and air inlet.

The path length of the cell is approximately 50 mm. It is used with the Michelson assembly using mercury green light, the telescope being used for observing the fringes.

The glass windows of the cell require compensation. This is provided by two glass discs of similar thickness which are held in a cell in the viewing axis 2 of the interferometer, at position shown in Fig. 3.



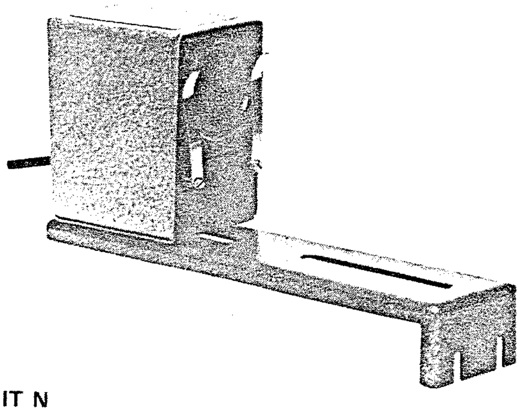
UNIT M

UNIT N.
TWIN LIGHT SOURCE

This contains two light sources in line, a 4 watt low pressure mercury vapour lamp in front and a 6·3 volt 0·3 amp tungsten lamp behind. It is operated through power unit O or P according to the mains voltage. To avoid accidental exposure of the eyes to the mercury lamp it is fitted with a glass window which should not be removed. Two stage clips to hold filters and a ground glass and green glass filter are included.

To change the lamps the housing is opened by unscrewing four small screws underneath and sliding the two components of the housing apart. A screwdriver with a 2 mm. wide blade is needed.

The lamp unit is held on a bracket by a bolt. The bracket has two slots to enable the lamp to be located for best illumination. When used in conjunction with a collimator as in the Twyman Green, the lamp is placed at the far end of the bracket but in other instances it is located as close as possible to the base. The bracket can be positioned at three different points for which holes are drilled in the side of the base as indicated in Figs. 3 and 8. In the Michelson and Twyman Green the lamp is on a low axis, the holes being near the lower edge of the base but in the Fabry-Perot assembly the holes are near the top of the casting to position the light in the upper axis.



UNIT N

TO OBTAIN INTERFERENCE FRINGES

MICHELSON INTERFEROMETER

INITIAL ADJUSTMENT

The interferometer is assembled in accordance with Fig. 3, ensuring that the mirror unit B is located on the quadrant approximately perpendicular to mirror unit A.

Switch-on the mercury lamp and clip the metal pointer onto the diffusing screen at the 12 o'clock position.

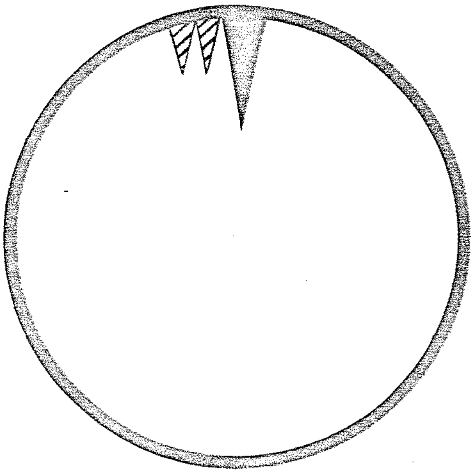


Fig. 4

Align the eye with the viewing axis about 25 cm. from the instrument. Three reflected images of the pointer will then be visible in the beam splitting head (Fig. 4). Slight adjustment of the tilt controls on unit B will indicate which of these can be moved. The initial adjustment consists of superimposing this image on the right-hand image of the stationary pair of images (Fig. 5).

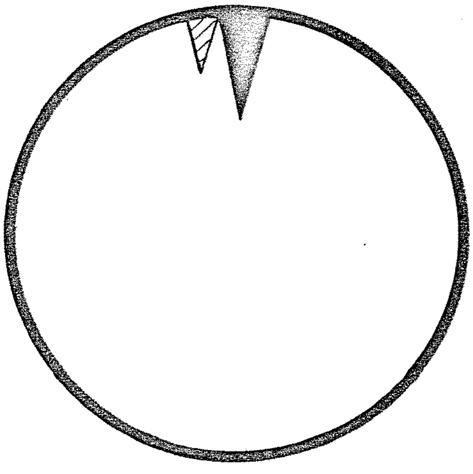


Fig. 5

Where the path lengths are unequal and the mirrors not parallel, hyperbolic fringes are obtained, which are composed of sections of circles surrounding a centre outside the field of view. By making careful adjustments to the tilting controls on mirror B, the mirrors can be set exactly parallel to each other to produce a pattern of circular fringes with the centre in the field of view. They are sited at infinity and some practice in relaxing the eye as if looking at a distant object may be necessary to view them. If there is little difference in the path lengths, few fringes will be present (Fig. 6).

To obtain zero path difference, turn the path length control in the direction which causes the circular fringes to collapse to the centre and as the paths become equal the pattern will decrease until only a single fringe will be visible.

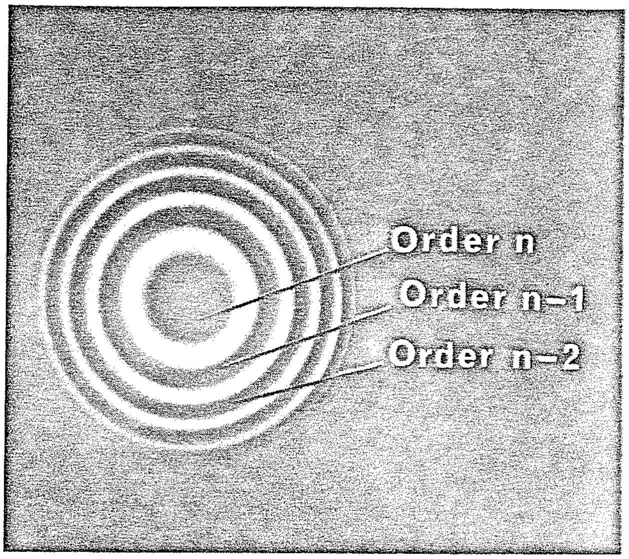


Fig. 6

When the path lengths are equal to within ±5 fringes it is possible to detect interference fringes by means of the tungsten light source (white light fringes).

When the tilt controls are adjusted using the mercury lamp a series of about ten vertical fringes will be produced. Turn the path length control until the fringes are straight (Fig. 7). Switch the tungsten lamp on and continue turning the path length control very slowly until a group of bright fringes with a distinctive dark band in the middle is seen. Bring the dark band to the centre and switch off the mercury lamp. The fringes will remain visible.

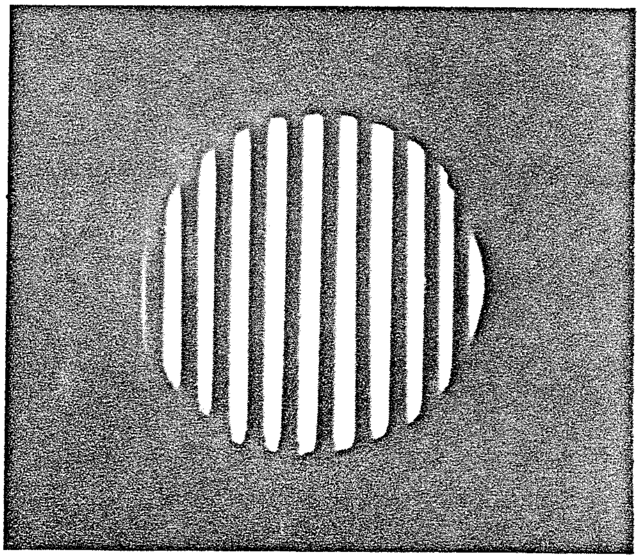


Fig. 7

An extremely small adjustment to the tilt controls will cause a single fringe to completely fill the field. If the fringe tends to pass out of the field the path length control should be adjusted to effect its re-entry.

When a very thin parallel plate of thickness d and refractive index λ is placed in the beam near either mirror A or B and covering half the field the fringes through the plate will be displaced. The retardation is $2d(\mu - 1)$, the air having been replaced by the material.

Since a displacement of one complete fringe is equivalent to a retardation of one wavelength, the thickness for a retardation of x fringes is:

$$d = \frac{x\lambda}{2(\mu - 1)}$$

the thickness being given in the same unit as that in which the main wavelength λ is measured.

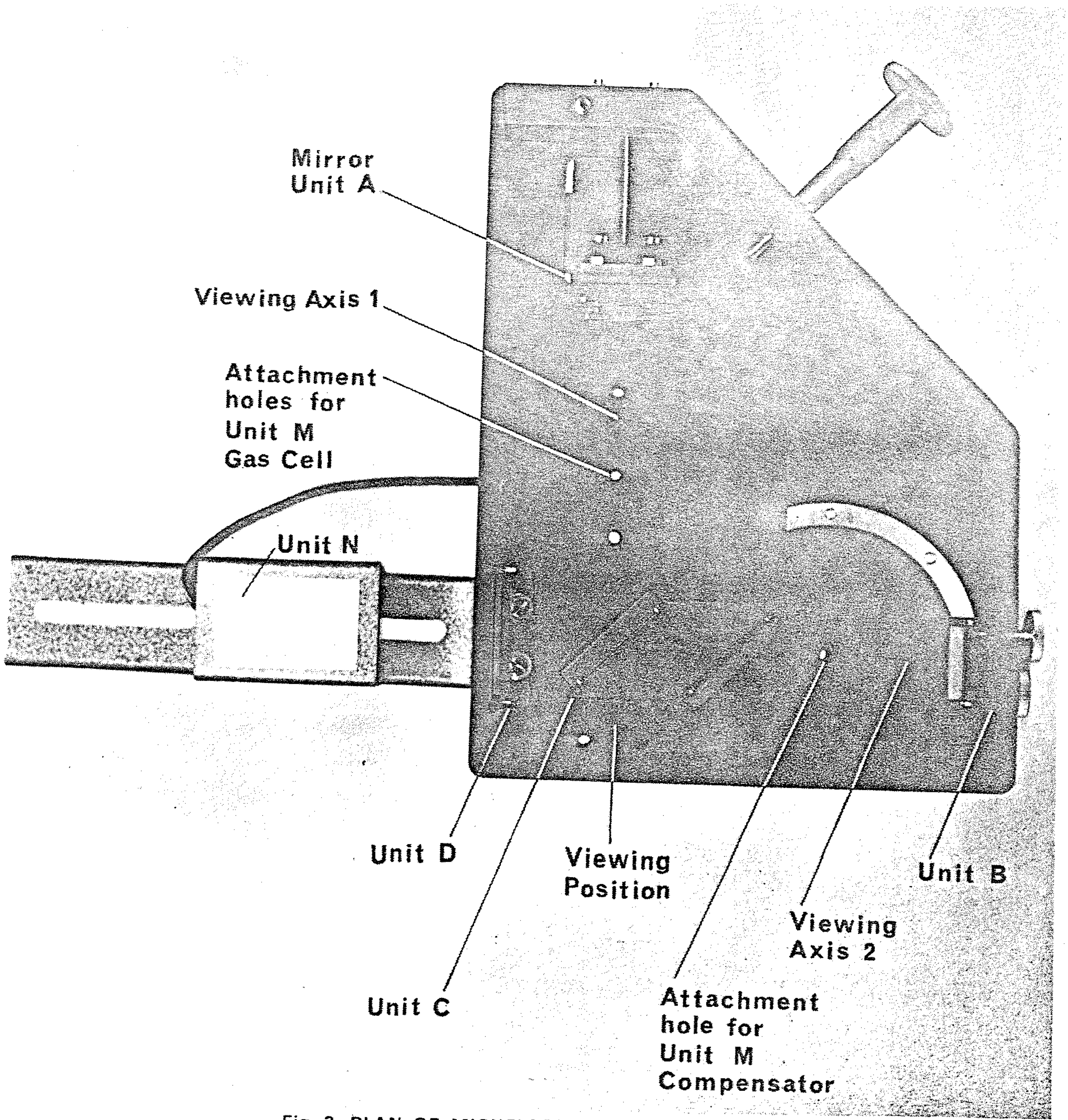


Fig. 3. PLAN OF MICHELSON INTERFEROMETER

FABRY-PEROT INTERFEROMETER

Assemble the interferometer in accordance with Fig. 8. The mirror of unit A is fitted in the upper position by unscrewing the two bolts and turning the mirror so that when re-assembled it faces in the same direction but is above the bolts. It should be set back as far as possible by unscrewing the micrometer of the path length control to the limit of its travel.

Fit the collector lens of unit L to unit A, but do not place the telescope in position.

Align the eye with the viewing axis about 25 cm. from the instrument and place the pointer between the lamp and the entrance aperture of the interferometer so that it appears in the field of view as shown in Fig. 9. The pointer should be about 10 cm. from the collecting lens. If the twin lamp unit N is employed, the pointer may be attached by means of the filter clips.

Two reflections of pointer will be seen and the mirror of unit E should be tilted by the controls until they are coincident. The pointer is then placed in position shown in Fig. 10 and the procedure repeated.

When these two adjustments have been made the mirrors are truly parallel to each other.

The fringes are located at infinity and are very narrow and bright on a broad dark background, see Fig. 11. As they are located at infinity it will be necessary to focus the telescope for a distant object prior to placing in the upper socket of unit H.

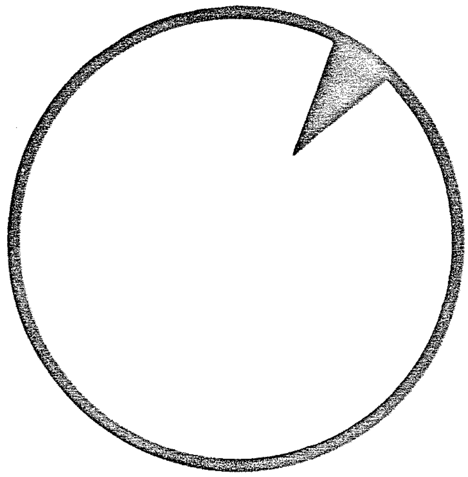


Fig. 10

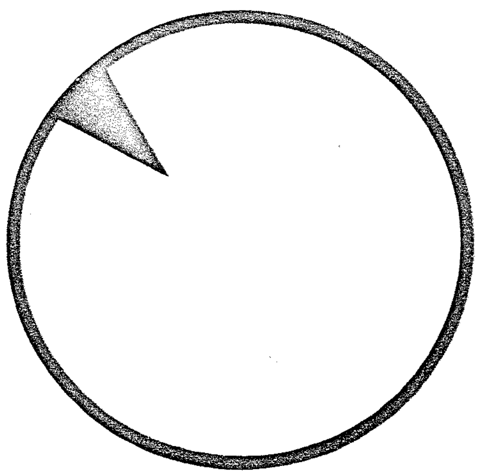


Fig. 9

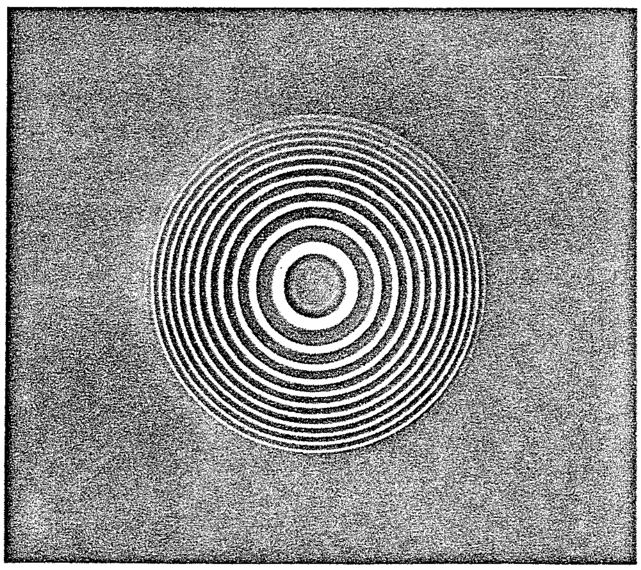


Fig. 11

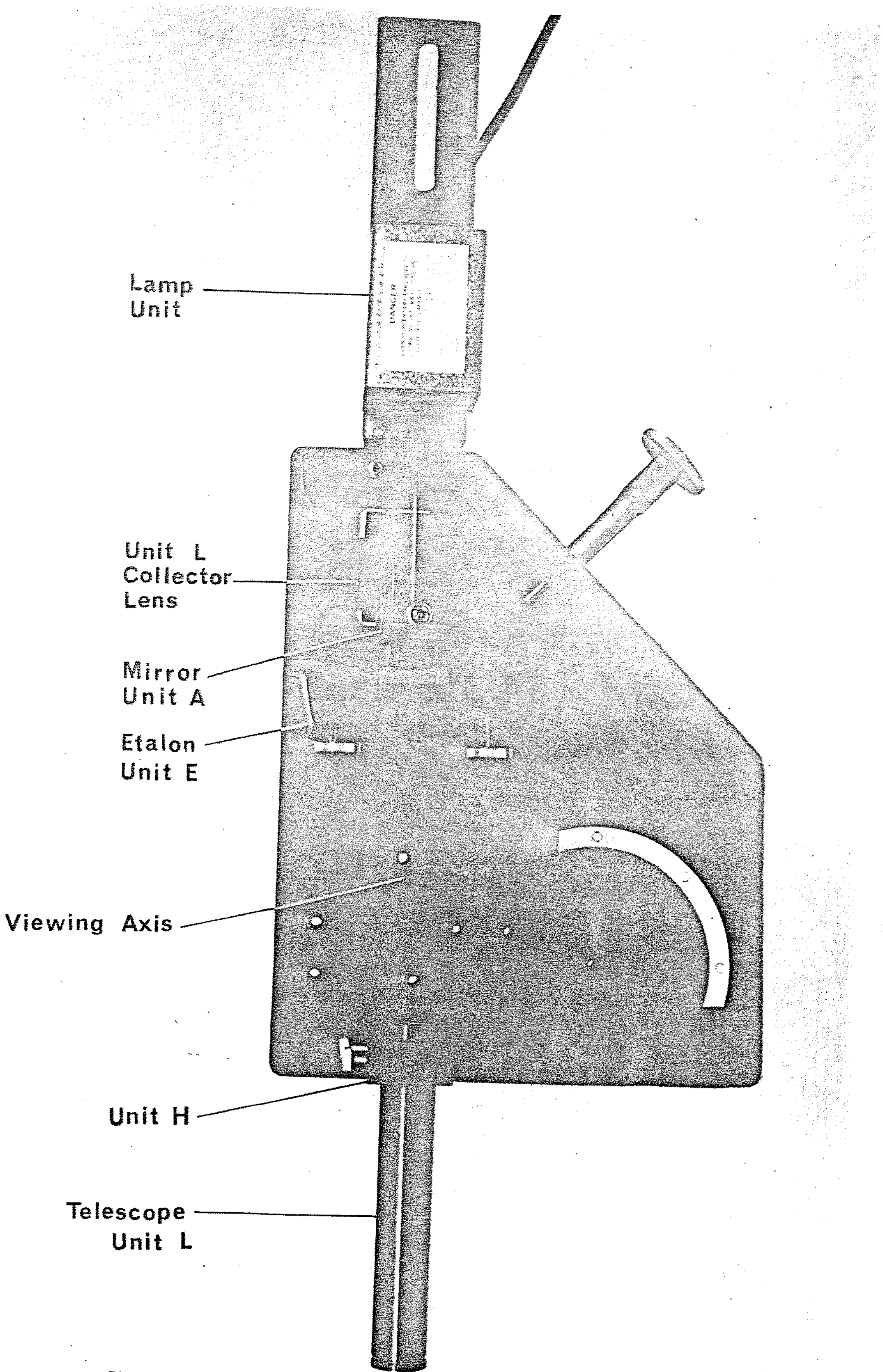


Fig. 8. PLAN OF FABRY-PEROT INTERFEROMETER

TWYMAN-GREEN INTERFEROMETER

The interferometer is first assembled as the Michelson, see Fig. 3, without the collimator or viewing tube, but with the diffusing screen and pointer, unit D and the lamp unit N in position. When the shadows of the pointer coincide as previously explained, curved interference fringes will be seen. The tilt screws of unit B should be adjusted until the fringes are circular, as Fig. 6.

Remove the diffuser unit D and insert collimator unit F, see (Fig. 12). The pinhole should be at the focus of the lens. This may be checked by pointing the collimator at a distant scene and examining the pinhole with a magnifier. The tube is slid in and out until the image of the distant scene seen through the pinhole is in focus at the same time as the pinhole. With the eye on viewing axis 1, about 40 cm. from the beam splitter it will now be possible to see an image of the pinhole reflected from mirror A. Adjust the two screws in the collimator cradle until this image appears in the centre of the mirror. Insert the viewing tube, unit G, in the lower socket of unit H with the lens towards the beam splitter and without the aperture pupil. If the eye is placed about 40 cm. from the end of the observing tube two small

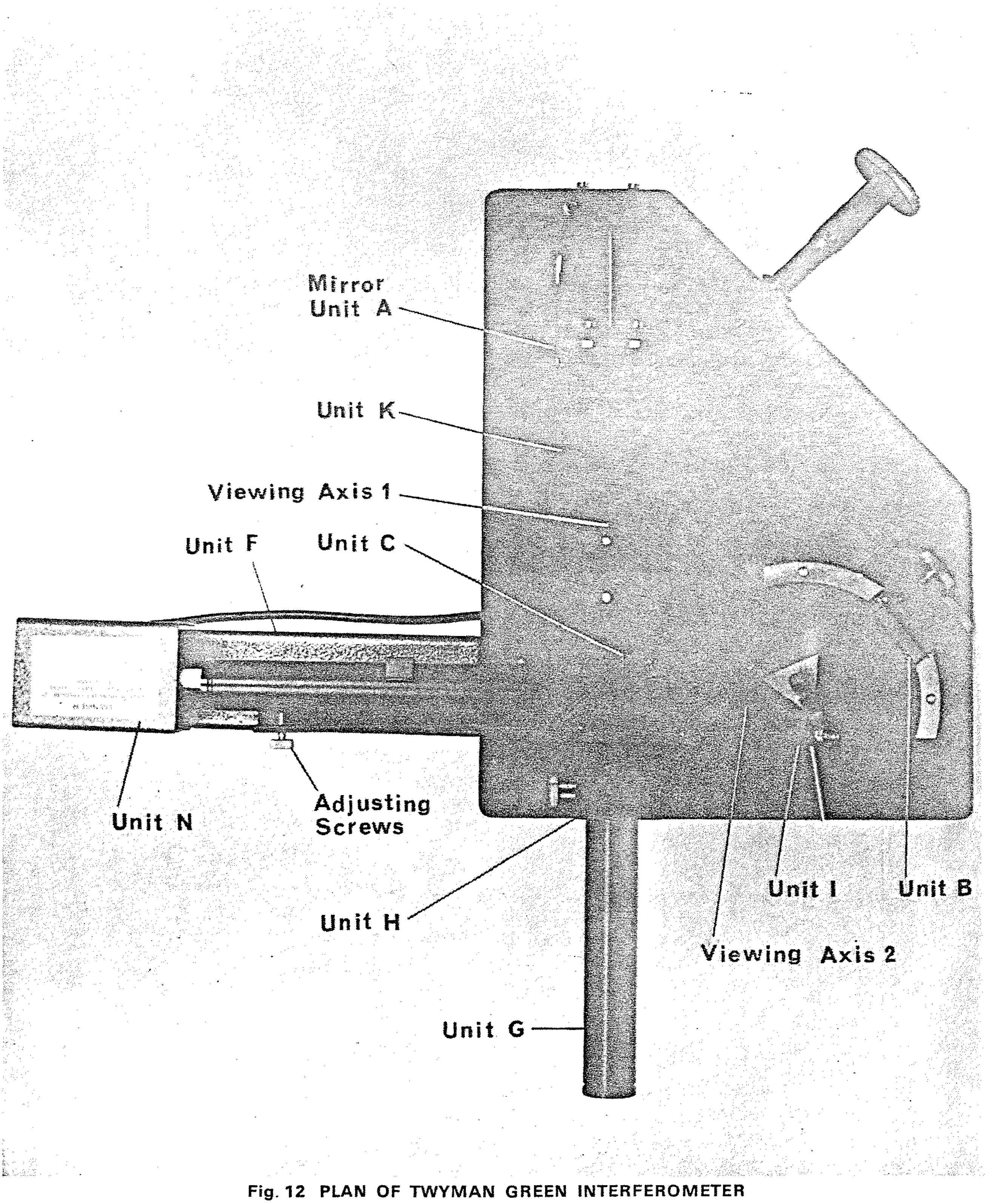


Fig. 12 PLAN OF TWYMAN GREEN INTERFEROMETER

images of the pinhole will now be seen located approximately at the end of the viewing tube. As the eye is moved closer so that the images fall in the eye pupil, a patch of light will be seen. Place the crossline unit K in front of mirror A. Shadows of this will be seen crossing the patch of light and if they are not coincident the light from the two arms of the interferometer is not retracing its path. The tilt screws of the collimator unit F should now be adjusted until the images of the crossline coincide.

When a prism for testing is inserted, the path length in viewing axis 2 is increased and must be compensated for by removing the two coloured distance pieces behind mirror A. The prism is placed on the levelling table unit I with the apex towards the support and the table rotated until the entry face is at an angle of approximately 50° to viewing axis 2 of the light from the beam splitter. Remove the viewing tube unit G and observing from this direction at about 40 cm. the image of the pinhole will be seen as previously. Unit B is then moved slowly around the quadrant, which should be loosened by the screws underneath, until coloured images of the pinhole are also seen when the screws can be tightened. If necessary adjust the tilt of the mirror of Unit B and of the level of the table unit I until the green image comes centrally in the field. As the prism holder is rotated the green image will move, become stationary and appear to begin to move in the opposite direction. This is the position of minimum deviation of the prism for green light. Adjust the tilt screws of mirror unit B until the green image coincides with the white image from viewing axis 1 of the interferometer. Insert the viewing tube unit G and place the green filter in front of the light, unit N. The two green images of the pinhole should then be coincident when viewed at about 40 cm. from the viewing tube, and, when the eye is moved up to the end of the tube, fringes will be seen crossing the field of view defined by the prism face. The form and tilt of the fringes can be changed by moving the adjusting screws on mirror unit B.

CARE OF THE INTERFEROMETER

The mechanical construction is such that it does not require any specific maintenance.

However, the aluminised mirrors are prone to damage, so care must be exercised when cleaning the surfaces. The mirrors should not be touched with the fingers or needlessly exposed to damp atmospheric conditions.

A dry squirrel-hair brush is useful for removing dust from the mirrors but, whenever possible, their serviceability can be prolonged by removing the units from the interferometer base and returning them to their original polythene wrappings. In this way the mirrors can be protected from atmospheric exposure and contamination by grease and dust.

If the mirrors cannot be cleaned sufficiently well by brushing, a piece of best quality cotton wool can be used to lightly buff the surfaces clean. Excessive pressure will cause gritty particles to penetrate the thin aluminium and silica coatings.

If mirrors become badly damaged they can be returned to us for re-coating. The mirrors are retained by masks that can be removed by releasing the screws at the sides of the units. Even when the aluminising is badly damaged the optically accurate glass plates are still valuable and they should be carefully packed to avoid damage in transit.

SPARES

25-8616 Spare mercury vapour lamp.

25-8624 Spare tungsten lamp.