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V. E. MATNER
REFLECTING DEVICES
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2,724,995

FIG. 1

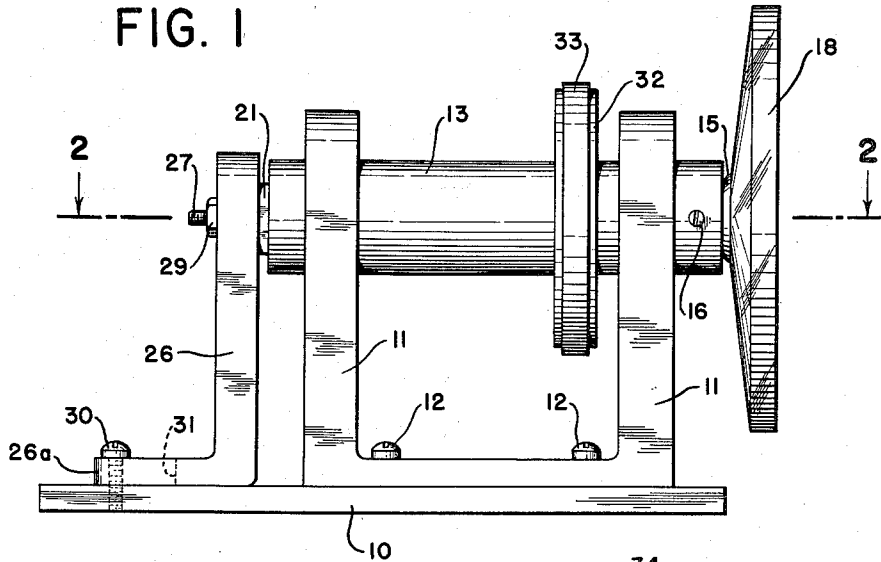


FIG. 2

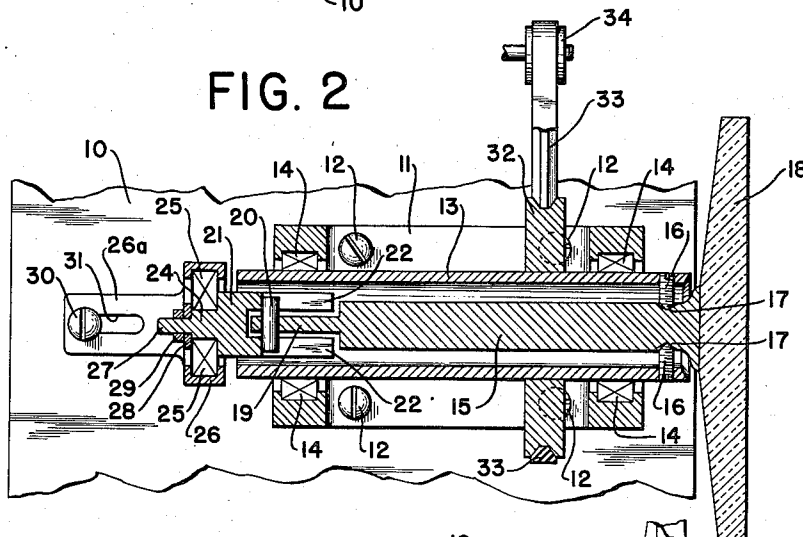


FIG. 3

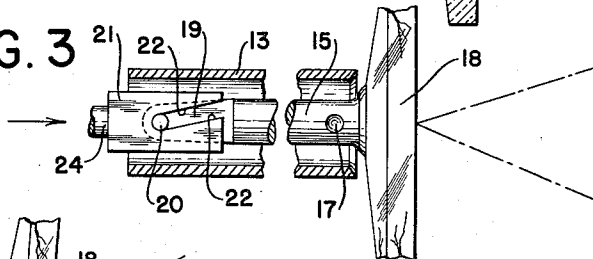
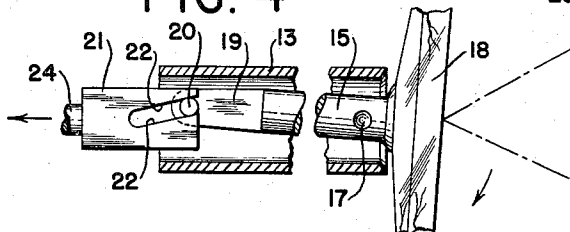


FIG. 4



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REFLECTING DEVICES

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7 Claims. (Cl. 88—74)

This invention relates to reflecting devices and is concerned more particularly with a novel reflecting device including a reflector, which is rotatable about an axis not normal to the reflecting surface and is capable of adjustment during the rotation of the reflector to vary the angle between its axis of rotation and a normal to the reflecting surface. The new device may be employed in various applications, and, when provided with an appropriate reflector, with radiation of various kinds. Since the device is light in weight and can be accurately balanced, the reflector can be rotated without significant vibration, and the possibility of varying the position of the reflector relative to its axis of rotation permits precise positioning of a beam of radiation reflected by the reflector. The new device may be advantageously used for various purposes, as in the monochromators and spectrometers described in the co-pending application of Scott and Offner, Serial No. 313,632, filed October 8, 1952.

The device of the invention includes a support rotatable on its longitudinal axis, and a shaft mounted on the support for rocking movement on an axis normal to the axis of rotation of the support and carrying a reflector having its plane normal to the axis of the shaft. The shaft can be rocked by means of a member, which is mounted on the support for rotation therewith and movement lengthwise of the axis of rotation of the support. The member and shaft have cooperating parts so formed that movement of the member axially of the support causes rocking of the shaft. One end of the member projects beyond the support and means engaging the projecting end of the member hold it in any selected position of adjustment, while permitting it to rotate. Accordingly, while the support is rotating, the member may be moved to rock the shaft to cause a normal to the plane of the reflector to make a desired angle with the axis of rotation of the reflector.

For a better understanding of the invention, reference is made to the drawing, in which

Fig. 1 is a side elevational view of a form of the new device;

Fig. 2 is a sectional view on the line 2—2 of Fig. 1; and

Figs. 3 and 4 are fragmentary views, partly in section and partly in elevation, showing the elements in different positions of adjustment of the reflector.

The new device in the form illustrated includes a base 10 and a standard 11 of U-shaped secured to the top of the base in any suitable way, as by screws 12. A support 13, illustrated as a sleeve, is mounted in the standard 11 for rotation in bearings 14, and shaft 15 is mounted within the sleeve 13 on a pair of set screws 16 which enter diametrically opposed notches 17 in shaft 15 and support the shaft for rocking movement on an axis normal to the longitudinal axis of the sleeve. One end of the shaft 15 extends out of the sleeve and a reflector 18 in the form of a plane mirror is mounted thereon with the plane of its reflecting surface normal

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to the longitudinal axis of the shaft. The other end of the shaft is provided with a tongue 19, in which is mounted a pin 20 lying parallel to the axis, on which the shaft is rockable, and projecting beyond opposite faces of the tongue.

A block 21 is mounted in and rotates with the sleeve 13, and extends out of the sleeve. The inner end of the block has a pair of spaced parallel arms 22, which receive the tongue 19 of the shaft between them and the arms are provided with slots inclined to the axis of sleeve 13 and receiving the ends of pin 20.

The exposed end of the block 21 has a section 24 of reduced diameter, which is mounted for rotation in a bearing 25 supported in a standard 26 having a foot 26a resting on base 10. Beyond section 24, the block has a threaded stem 27 projecting beyond bearing 25 and carries a washer 28 held against the outer face of the bearing by a nut 29 on the stem. The foot of standard 26 is secured to the base by a screw 30 extending through a slot 31 in the foot and into the base. The standard may thus be moved in a direction lengthwise of sleeve 13 and such movement moves the block 21 and rocks the shaft 15.

The sleeve 13 may be rotated in convenient manner, as by a pulley 32 encircling the sleeve and connected by a V-belt 33 to a driving pulley 34.

In the operation of the new reflecting device, the direction taken by a ray of light, which falls upon the nutating mirror 18 and is reflected therefrom, will depend, among other things, upon the angle of tilt of the mirror, that is, the angle between a normal to the surface of the mirror and the axis of rotation of the mirror. This will be apparent from a consideration of Figs. 3 and 4. In Fig. 3, the mirror is shown as lying with its surface normal to its axis of rotation and thus with a zero angle of tilt, while, in Fig. 4, the mirror is shown as having the maximum angle of tilt. The dotted line in each figure represents the path of a ray of light falling upon the mirror and reflected therefrom and the change in the path of the reflected ray resulting from the change in the angle of tilt of the mirror is readily observable.

In applications, in which the angle of tilt of a nutating mirror is critical, it would be difficult to mount the mirror on the shaft at the precise angle desired. However, when the new device is employed, this difficulty is overcome by mounting the mirror with its reflecting plane at right angles to the axis of the shaft and then rocking the shaft on its support to vary the angle of tilt of the mirror. Because of the possibility of varying the angle of tilt of the mirror during the rotation of the mirror, it is not necessary that the mirror be initially mounted with complete accuracy on the shaft, although it is, of course, desirable that the plane of the mirror lie approximately at right angles to the axis of the shaft.

Monochromators or spectrometers of the type disclosed in the application of Scott and Offner above identified make possible the rapid scanning of a wavelength interval of the spectrum and depend for their operation on the use of a nutating mirror. The length of the interval scanned depends on the angle of tilt of the mirror and, if the mirror is fixed on the shaft and the shaft mounted for rotation on its axis in fixed bearings, a variation in the angle of tilt of the mirror can be obtained only by removing the shaft and mirror and substituting another, in which the mirror has the desired angular mounting relative to the shaft. When the device of the invention is employed in such instruments, the possibility of varying the angle of tilt of the mirror, while it is rotating, simplifies both the initial adjustment of the instrument and variation in the length of the interval of the spectrum to be scanned.

I claim:

1. A reflecting device, which comprises a hollow elongated support mounted for rotation on its longitudinal axis, means on the support, by which the support may be rotated; a shaft mounted within the support for rocking movement on an axis normal to the axis of rotation of the support, the shaft having one end projecting out of the support, a reflector mounted on said end of the shaft with its plane substantially normal to the axis of the shaft, and means engaging the shaft at a distance from the mirror and movable to rock the shaft.

2. A reflecting device, which comprises a support of tubular form mounted for rotation on its longitudinal axis, means on the support, by which the support may be rotated, a shaft mounted within the support for rocking movement on an axis normal to the axis of rotation of the support, the shaft having one end projecting out of the support, a member mounted adjacent the support for coaxial rotation therewith and movement lengthwise of the support, cooperating means on the member and shaft including a cam and operable on movement of the member lengthwise of the support to rock the shaft, and a reflector mounted on said end of the shaft with its plane substantially normal to the axis of the shaft.

3. A reflecting device, which comprises a support mounted for rotation, a shaft mounted on the support for rocking movement on an axis normal to the axis of rotation of the support, the shaft having one end lying beyond the support, a reflector mounted on said end of the shaft with its plane substantially normal to the axis of the shaft, a member mounted on the support for rotation therewith and movement lengthwise of the support, a cam surface on the member, and means on the shaft engaged by the cam surface, the cam surface operating on movement of the member lengthwise of the support to rock the shaft.

4. A reflecting device, which comprises a support mounted for rotation, a shaft mounted on the support for rocking movement on an axis normal to the longitudinal axis of the support, the shaft having an end projecting beyond the support, a reflector mounted on said end of the shaft with its plane substantially normal to the axis of the shaft, a member mounted on the support for rotation therewith and movement lengthwise of the support, a pair of spaced arms on the member receiving the shaft between them, cam surfaces on the arms, and means on the shaft engaging the cam surfaces, the surfaces operating on movement of the member lengthwise of the support to rock the shaft.

5. A reflecting device, which comprises a sleeve mounted for rotation on its longitudinal axis, a shaft mounted within the sleeve for rocking movement on an

axis normal to the longitudinal axis of the sleeve, the shaft extending out of the sleeve; a reflector mounted on the exposed end of the shaft with its plane substantially normal to the axis of the shaft, a member mounted adjacent the sleeve for rotation coaxially therewith and movement axially of the sleeve, cooperating means on the member and shaft including a cam and operable on movement of the member axially of the sleeve to rock the shaft, and means supporting the member for rotation and adjustable to vary the position of the member axially of the sleeve.

6. A reflecting device, which comprises a base, a standard secured to the base, a sleeve mounted in the standard for rotation on its longitudinal axis, a shaft mounted within the sleeve for rocking movement on an axis normal to the longitudinal axis of the sleeve, the shaft extending out of the sleeve, a reflector mounted on the exposed end of the shaft with its plane substantially normal to the axis of the shaft, a member mounted adjacent the sleeve for rotation coaxially therewith and movement axially of the sleeve, co-operating means on the member and the shaft including a cam and operable on movement of the member axially of the sleeve to rock the shaft, a support encircling the exposed end of the member and holding the member against endwise movement while permitting its rotation, and means for securing the support to the base in different positions of adjustment in a direction lengthwise of the sleeve.

7. A reflecting device, which comprises a base, a standard secured to the base, a sleeve mounted in the standard for rotation on its longitudinal axis, a shaft mounted within the sleeve for rocking movement on an axis normal to the longitudinal axis of the sleeve, the shaft extending out of the sleeve; a reflector mounted on the exposed end of the shaft with its plane substantially normal to the axis of the shaft, a member mounted in the sleeve for rotation therewith and movement lengthwise of the sleeve, the member extending out of the sleeve, a pair of spaced arms on the member within the sleeve receiving the shaft between them, cam surfaces on the arms, a pin on the shaft engaging the cam surfaces, the surfaces and pin cooperating on movement of the member lengthwise of the sleeve to rock the shaft, a support encircling the exposed end of the member and holding the member against endwise movement while permitting its rotation, and means for securing the support to the base in different positions of adjustment in a direction lengthwise of the sleeve.

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