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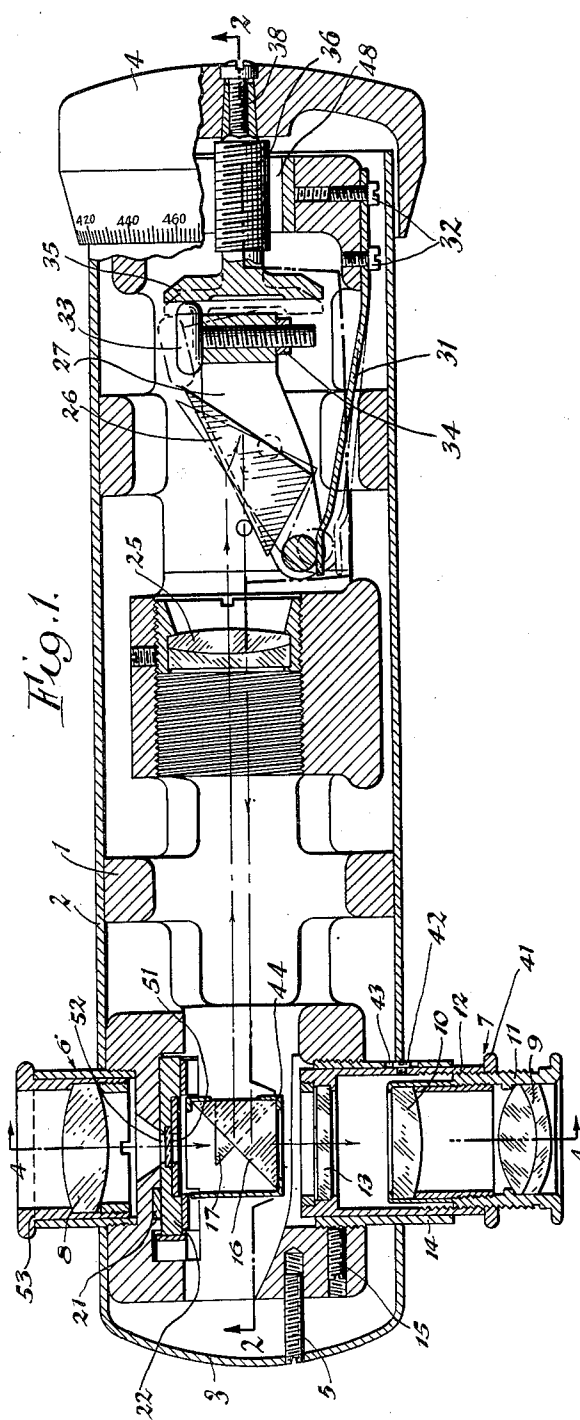
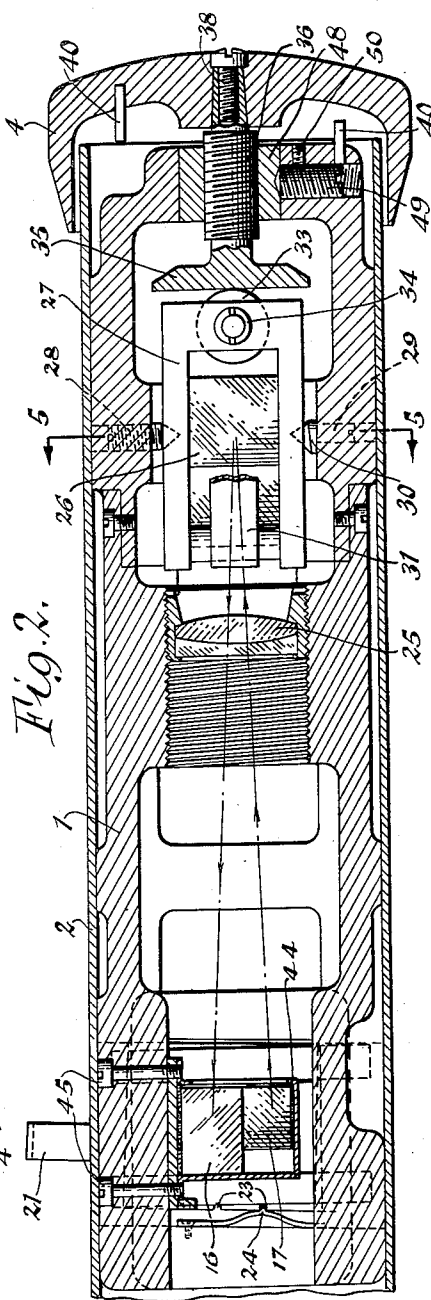
R. S. ESTEY ET AL

2,330,694

SPECTROMETER

Filed May 9, 1941

2 Sheets-Sheet 1



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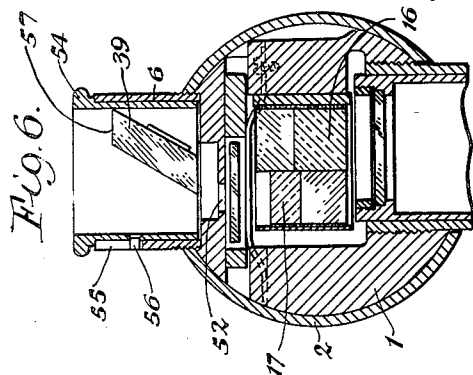
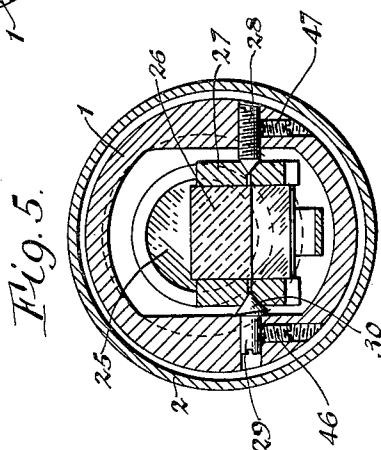
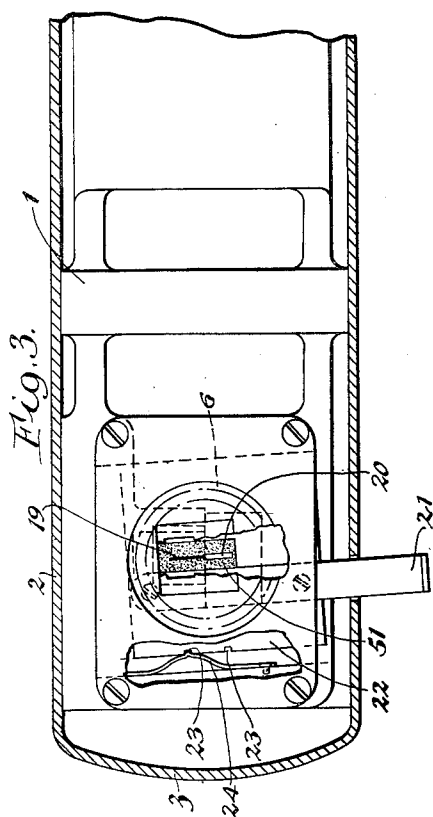
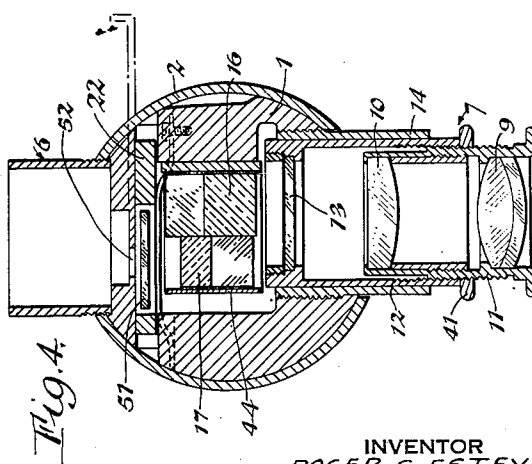
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2 Sheets-Sheet 2



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UNITED STATES PATENT OFFICE

2,330,694

SPECTROMETER

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5 Claims. (Cl. 88—14)

This invention relates to spectrometers or spectroscopes or the like and has particular reference to instruments of that type having the capability and advantages of laboratory instruments and yet having the compactness and portability of a pocket instrument.

A principal object of the invention is to provide a device of the type set forth having a sufficiently long spectrum that a wavelength scale may be used for identifying the detail characteristics of the spectrum and which device is compact and readily portable.

Another object of the invention is to provide a device of the type set forth in which the entrance and exit windows are close to each other.

Another object of the invention is to provide a device of the type set forth which will allow of direct vision, that is, will allow the observer to look substantially in the direction of the object being observed.

Another object of the invention is to provide a device for qualitative spectrochemical analysis which is simple, efficient, convenient and economical and more readily portable than prior devices.

Other objects and advantages of the invention will be apparent from the following description taken in connection with the accompanying drawings. It will be understood that many changes may be made in the details of construction and arrangements of parts without departing from the scope of the invention as expressed in the accompanying claims.

The arrangement of parts and details of construction shown in the accompanying drawings are illustrative of one form of the invention.

Referring to the drawings:

Fig. 1 is a sectional view of a device embodying the invention;

Fig. 2 is a sectional view taken on line 2—2 of Fig. 1 looking in the direction of the arrows;

Fig. 3 is a partial sectional view showing the slit mechanism;

Fig. 4 is a sectional view taken on line 4—4 of Fig. 1 looking in the direction of the arrows;

Fig. 5 is a sectional view taken on line 5—5 of Fig. 2 looking in the direction of the arrows; and

Fig. 6 is a view similar to Fig. 4 but showing a modified form of the invention.

In the past there have been numerous devices constructed for approximate qualitative spectrochemical analysis and similar uses. These devices, however, have been principally large laboratory instruments which were not readily

portable and the instruments which have been made portable have not had the capabilities required for qualitative spectrochemical analysis, that is, the devices which have had the necessary requirements have not been portable and the devices which have been portable have not had satisfactory capabilities.

It is therefore one of the principal objects of the present invention to provide a device of the type set forth which will have the capabilities of a laboratory type instrument and yet be so compact as to be readily portable.

Referring more particularly to the drawings wherein similar reference characters designate corresponding parts throughout the several views, the device shown embodying the invention comprises a body portion 1, cover 2, cap 3, and wavelength drum 4.

The cap 3 is secured in position by the screw 5 which is screwed into the end of body portion 1. Secured to the body portion 1 adjacent the forward end thereof is the entrance window 6 and the eyepiece 7 which are substantially aligned with each other and on opposite sides of the body 1. The entrance window 6 may be provided with the condensing lens 8 if desired.

The eyepiece is of the focusing variety containing the ocular and field lens elements 9 and 10 fitted in the tubular member 11 which is threadedly adjustable in the tube 12. Adjacent the inner end of the tube 12 is secured the reticle member 13 having the cross lines thereon. The tube 12 is in turn fitted into the tube 14 which tube 14 is locked in position by means of the set screw 15.

The eyepiece lenses 9 and 10 are contained in the threaded mount 11 and the threads of said mount 11 engage with similar threads on tube 12 and permit the eyepiece to be focussed on the reticle 13. The focal adjustment can be locked by the lock nut 41 which is threaded on the tube 11 and locks against the end of tube 12. The eyepiece and reticle assembly is focusable to bring the spectral image into the plane of the reticle 13 by means of the telescoping tubes 12 and 14. The movement of these tubes is limited by the screw 42 which operates in the slot 43.

The device is provided with the reflecting prisms 16 and 17 mounted one above the other. The prism 17 is aligned with the entrance window and adapted to receive light entering through said entrance window and to reflect said light along the axis of the instrument and through the objective 25.

After passing through the objective 25 the

light reaches the dispersing prism 26. The back surface of this prism is coated with silver or other reflecting material. Rays of a selected color or wavelength pass into this prism at such an angle that they are refracted into the body of the prism, meet the rear silvered reflective surface thereon and are reflected back by said reflective surface over substantially the same path.

The entrance window and associated prism 17 are slightly below the longitudinal axis of the device so that the incoming rays strike the dispersing prism 26 at an angle from below the axis and leave the prism, after reflection, at an angle leading above the axis. These rays are shown in Fig. 2. The returning rays pass through the objective 25 and enter the reflecting prism 16 and are imaged in the plane of the reticle 13 where they form a spectrum which has the selected wavelength at the intersection of the cross lines. This entire spectrum and the cross lines are seen through the eyepiece.

Elements 16 and 17 are held in a mount 44 attached to the body 1 by the screws 45.

The light received through the entrance window 6 by the prism 17 is reflected through the body of the instrument through the telescope objective 25 into the prism 26 and then reflected back by the prism 26 into the prism 16 as previously described. The prism 26 is mounted on the adjustable mounting 27. This mounting is adjustably and pivotally supported on the pivot screws 28 and 29.

The pivot 29 is provided with the eccentric shouldered head 30 to allow the prism support 27 to be laterally adjusted by rotation of the said pivot 29. The position of the pivot 29 can be locked by the set screw 46. The tightness of the pivot bearings 28 and 29 can be adjusted by turning the pivot screw 28 thereby tightening or loosening the pivots 28 and 29 in their tapered or conical seats in the member 27. The adjustment of screw 28 may be locked by set screw 47.

The adjustment just described serves to tip the prism 26 about a horizontal axis thereby raising or lowering the image of the spectrum with respect to the cross lines on the reticle 13.

The pivots 28 and 29 provide pivot points for the prism support 27 as shown in Fig. 2. The leaf spring 31 is secured to the outer end of the body 1 by the screws or the like 32 and maintains pressure against the prism support 27 which in turn through the adjusting screw 33 maintains pressure against the wavelength cam 35. The adjusting screw 33 is adjacent the outer end of the prism support 27 and is threadedly connected to the prism support 27. The adjusting screw 33 is threadedly connected to said prism support 27 to allow an adjustment of the effective lever arm by which the wavelength cam 35 rotates the prism support 27. When the adjusting screw 33 has been placed in adjusted position the nut 34 is tightened to lock the adjusting screw in said adjusted position.

The cam 35 has the threaded extension 36 which threads through the split nut 48 which is mounted in the end of the body 1. Screw 49 serves to locate and adjust the nut 48 and screw 50 locks screw 49 in adjusted position. The member 36 has an extension portion having a tapered outer surface on which the wavelength drum 4 is adapted to be positioned and said drum is adapted to be locked in adjusted position by means of the locking screw or the like 38.

Pins 40 are so positioned as to prevent more than a single rotation of the wavelength drum 4.

Thus by rotating the wavelength drum the cam 35 which engages the head of the adjusting screw 33 rotates the prism support 27 and prism 26 as desired. For example, see Fig. 1 wherein there is shown in dotted lines the adjusting screw and prism in adjusted position against the action of the spring 31. When the cam 35 is turned in appropriate direction the spring 31 again forces the prism support 27 and prism back into the position shown in full lines in Fig. 1.

The wavelength drum 4 carries a scale whose marks are so spaced as to indicate the wavelength of the portion of the spectrum which intersects the cross lines on reticle 13 when an index mark on the casing coincides with the corresponding mark of the wavelength scale.

In Figs. 3 and 4 is shown the slit mechanism.

This arrangement consists of slit plate 51 which contains two transparent rectangular apertures or slits 19 and 20. These slits are of different widths. The slit plate 51 is mounted in a frame 22 which is slidable in a substantially vertical direction by means of handle 21 and can be located in either of two selected positions by means of the detent on the spring 24 which engages either of the two notches 23 in the frame 22, thus bringing either of the slits 19 or 20 into the operating point of the instrument.

The slits and slit mechanism are set at a slight angle to the vertical as shown in Fig. 3 in order to compensate for the twist produced by the rest of the optical system and to permit the slit image which falls on reticle 13 to be truly vertical. The effective length of the active slit 19 or 20, as the case may be, is controlled by the aperture 52 in the body 1.

The entrance window 6 is represented by a draw tube adapted to receive a selection of accessories such as, for example, the lens 8 in its mount 53 or the comparison prism 39 in its mount 54. The draw tube 6 is slotted on one side at 55 to receive the locating pin 56 of the mount 54 or a corresponding pin of any other accessory part which needs to be accurately located.

The lens 8 serves to focus a nearby source of light onto the slit 19 or 20 to increase the illumination thereof and facilitate the examination of the aforesaid source of light.

The comparison prism 39 permits two separate parallel beams of light to enter the slit 19 or 20, one passing through the unobstructed aperture 52 and the other passing into the entrance surface 57 of the comparison prism 39. Thus two parallel beams having a moderate transverse displacement from one another can be compared.

It is pointed out that when using the present device the operator is looking substantially toward the object under examination, that is, it is a direct vision type of instrument which because of the construction allows the entrance window and eyepiece to be relatively close to one another and also because of the doubling of the length of the light beam as described above, allows the instrument to be so compact as to be readily portable and yet provides such an instrument having all of the uses and capabilities of a larger laboratory type of device.

In using the instrument the operator looks into the eyepiece 7 and directs the entrance window 6 toward the object to be examined, such as a light source where it is desired to distinguish the

chemical composition of the emitting substance or to determine the suitability of the light source for some particular use or to examine the light absorbing characteristics of transparent colored substances. The wavelength drum 4 is then rotated to rotate the prism 26 as previously described until the light is seen in the eyepiece and the desired area of the spectrum is in line with the cross lines of the reticle 13. The drum reading is then taken to obtain the desired information.

Where the colors seen in the instrument blend or overlap with each other it is usually desirable to employ the narrow slit 19, and where the bands do not overlap or blend or where the light under examination is very faint, the wider slit 20 may be employed.

From the foregoing it will be seen that we have provided simple, efficient and economical means for obtaining all of the advantages of the invention.

Having described our invention, we claim:

1. In a device of the character described, a compact and portable device comprising a longitudinal body portion, an entrance window and an eyepiece on opposite sides of said body portion, said entrance window and eyepiece being substantially in alignment with each other to allow the observer to look substantially in a direction towards the object being observed, a dispersing and reflecting member adjustably mounted in said body portion and spaced from the eyepiece and entrance window, means on said body portion for varying the position of said dispersing and reflecting member, a reflector member in said body aligned with said entrance window for reflecting light entering said body through said window to said dispersing and reflecting member, and a reflector member in said body aligned with said eyepiece for reflecting light received from said dispersing and reflecting member through the eyepiece into the eye of the observer, said reflector member aligned with said entrance window and said reflector member aligned with said eyepiece being in adjacent relation and the reflective surface of one of said members being substantially at right angles to the reflective surface of the other of said members.

2. In a device of the character described, a compact and portable device comprising a longitudinal body portion, an entrance window and an eyepiece on opposite sides of said body portion, said entrance window and eyepiece being substantially in alignment with each other to allow the observer to look substantially in a direction towards the object being observed, a dispersing and reflecting member adjustably mounted in said body portion and spaced from the eyepiece and entrance window, a rotary member rotatably mounted on an end of said body portion for varying the position of said dispersing and reflecting member, a reflector member in said body aligned with said entrance window for reflecting light entering said body through said window to said dispersing and reflecting member, and a reflector member in said body aligned with said eyepiece for reflecting light received from said dispersing and reflecting member through the eyepiece into the eye of the observer, said reflector member aligned with said entrance window and said reflector member aligned with said eyepiece being in adjacent relation and the reflective surface of one of said members being substantially at right angles to the reflective surface of the other of said members.

3. In a device of the character described, a compact and portable device comprising a longitudinal body portion, an entrance window and an eyepiece on opposite sides of said body portion, said entrance window and eyepiece being substantially in alignment with each other to allow the observer to look substantially in a direction towards the object being observed, a dispersing and reflecting member adjustably mounted in said body portion and spaced from the eyepiece and entrance window, a rotary member rotatably mounted on an end of said body portion for varying the position of said dispersing and reflecting member, a reflector member in said body aligned with said entrance window for reflecting light entering said body through said window to said dispersing and reflecting member, and a reflector member in said body aligned with said eyepiece for reflecting light received from said dispersing and reflecting member through the eyepiece into the eye of the observer, said reflector member aligned with said entrance window and said reflector member aligned with said eyepiece being in adjacent relation and the reflective surface of one of said members being substantially at right angles to the reflective surface of the other of said members and a scale member on said rotary member for indicating the character of the light seen in the eyepiece.

4. In a device of the character described, a compact and portable device comprising a longitudinal body portion, an entrance window and an eyepiece on opposite sides of said body portion, said entrance window and eyepiece being substantially in alignment with each other to allow the observer to look substantially in a direction towards the object being observed, a dispersing and reflecting member adjustably mounted in said body portion and spaced from the eyepiece and entrance window, a rotary member rotatably mounted on an end of said body portion for varying the position of said dispersing and reflecting member, a reflector member in said body aligned with said entrance window for reflecting light entering said body through said window to said dispersing and reflecting member, and a reflector member in said body aligned with said eyepiece for reflecting light received from said dispersing and reflecting member through the eyepiece into the eye of the observer, said reflector member aligned with said entrance window and said reflector member aligned with said eyepiece being in adjacent relation and the reflective surface of one of said members being substantially at right angles to the reflective surface of the other of said members, a rider connected with said dispersing and reflecting member and an adjustable member connected with said rotary member for adjusting said dispersing and reflecting member and contacting said rider member.

5. In a device of the character described, a compact and portable device comprising a longitudinal body portion, an entrance window and an eyepiece on opposite sides of said body portion, said entrance window and eyepiece being substantially in alignment with each other to allow the observer to look substantially in a direction toward the object being observed, a dispersing and reflecting member adjustably mounted in said body portion and spaced from the eyepiece and entrance window, means on said body portion for varying the position of said dispersing and reflecting member, a reflector member in said body aligned with said entrance win-

dow for reflecting light entering said body through said window to said dispersing and reflecting member, and a reflector member in said body aligned with said eyepiece for reflecting light received from said dispersing and reflecting member through said eyepiece into the eye of the observer, the reflective surfaces of said reflector member aligned with said entrance window and said reflector member aligned with said eyepiece being

adjacent each other and being so positioned relative to each other according to the line of travel of the light rays to and from the reflecting and dispersing member as to cause the light entering the entrance window and the line of sight through said eyepiece to be substantially in alignment.

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