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DIFFRACTION GRATING INSTRUMENT DIALS

Filed April 10, 1967

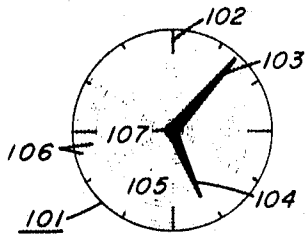


FIG. 1

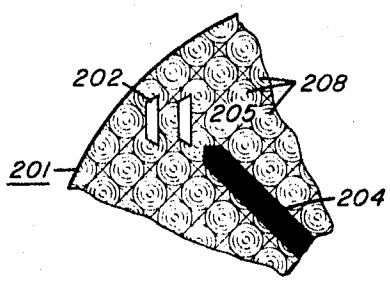


FIG. 2

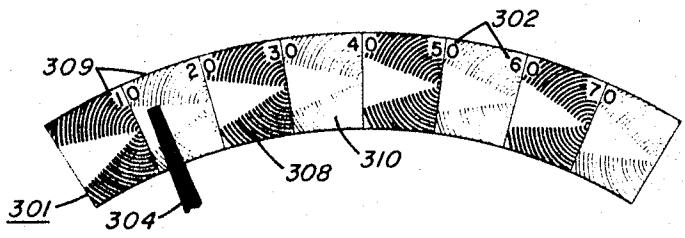


FIG. 3

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DIFFRACTION GRATING INSTRUMENT DIALS

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U.S. Cl. 116—129 3 Claims

ABSTRACT OF THE DISCLOSURE

Instrument dials having faces comprising spirally ruled optical diffraction gratings arranged to provide optimum spectral-color contrast with instrument pointers superimposed on the dials.

This invention relates generally to indicating instruments having faces and hands or pointers, and particularly to those in which the hand covers a part of the face, as, for example, in most watch, compass and meter dials.

The essence of this invention lies in the provision of instrument faces having spiral rulings of proper ruling spacing to diffract ambient light into its component colors, and in arrangement of the rulings to set-off the superimposed indicator hands by color contrast.

Engine turning of instrument faces for embellishment and as an aid in producing contrast between face and hand in dim light, has long been practiced. New, however, are the advantages of the present invention, which retains the traditional merits of engine turning, and in addition provides for contrast between instrument face and hand in diffracted spectral colors which change with the observer's position.

As an example of one application, wearers of wrist watches to which this invention has been applied observe, as the wrist is moved, a play of colors across the face of the watch, diffracted from the ambient lighting except where obscured by the watch hands, which stand out in bold contrast.

Again, where several dial instruments are displayed together, an instrument made according to this invention stands out conspicuously to the observer's eye, which is drawn to the color-silhouetted hands. It is obvious that this aspect of the invention is adaptable to industrial uses.

These and other advantages and objects of the invention will become apparent through a study of the specification and drawings in which:

FIG. 1 is a face view of a watch dial;

FIG. 2 shows a portion of an instrument dial;

FIG. 3 is a face view of an instrument dial.

FIG. 1 shows this invention embodied in a wrist watch dial **101**, with time graduations **102**, hands **103** and **104**, face **105**, and rulings **106** on the face.

The hands are of conventional design and are preferably flat black to prevent specular reflection.

The face is made of a single optical diffraction grating of about 15,000 lines per inch spacing, ruled in a spiral which is centered on the axis of **107**, of the hands.

Under most lighting conditions spectral colors diffracted by the rulings appear on the face of the watch in symmetrically opposed sectors having apices at the center of the spiral. The azimuthal position on the spiral grating of the opposed sectors is a function of the observer's angle with respect to the grating and the source of illumination.

Appropriate small changes of angle of the watch with respect to the observer cause the opposed sectors, which, in response, appear to rotate about the axis of the hands, to sweep around the entire face of the watch so that the watch hands are seen against a background of varying illumination and color.

The spirally or circularly ruled optical diffraction grating is uniquely suited to this application. Spiral gratings exhibit a universality of color display—color will appear under direct illumination from any angle, and will be visible at all angles about the gratings.

Straightline gratings, on the other hand, are not well suited to this and similar applications because the geometry of their rulings severely restricts the position angles in which color diffracted by them can be observed.

FIG. 2 shows an embodiment of the invention adapted to applications requiring that color contrast between instrument face and hand be visible at all observer positions, without necessity for tipping the instrument.

To provide this advantage, the instrument face **205**, of which a segment is shown in a dial segment **201**, is made of a mosaic of spiral diffraction gratings **208**. These gratings are so proportioned and related to the size and position of the instrument hand **204**, that the hand obscures at any position a portion of the sectors of diffracted light which observers wtould otherwise see, and thus appears against a color background from all observing angles. A proportion insuring this relation is: grating diameter less than twice handwidth.

FIG. 3 shows the invention embodied in a dial similar to those used in speedometers, voltmeters, and the like.

Graduated segments **309** of the instrument face are made of separate spiral gratings **308**, in a special mosaic. Some of the gratings can be ruled with different characteristics as, for example, with different ruling spacings, or with different blaze angles produced by varying the groove-shape of the rulings according to methods known in the art, to produce color graduation of the dial. In FIG. 3 alternate sectors **310** are differently marked to indicate this provision of varied contrast between indicator hand **304** and dial **301**. The dial may also be flat, convex or concave.

The gratings required for this and the other embodiments of the invention may be made by impressing the aluminized face of a sheet of cellulose acetate with a metal die, the die having a spiral ruled in its face by the diamond tool of a spiral ruling engine according to techniques known in the art. A mosaic of gratings may be formed by trimming individual gratings to the desired outline, and cementing them adjacent to each other on a smooth surface. Providing the gratings with self-adhesive backing facilitates the assembly. The graduation markings **102**, **202**, and **302** in the respective figures can be painted on the faces of the dials. They can also be made through inlay techniques by using a die which has been relieved according to conventional methods to leave unruled the area of the marking.

Aspects of these disclosed methods appear also in my copending United States patent applications No. 467,312 entitled Diffraction Type Mosaic System, filed June 28, 1965; No. 606,988 entitled Inlay Diffraction Gratings, filed Jan. 3, 1967; and No. 615,421 entitled Self Adhesive Diffraction Gratings, filed Feb. 13, 1967.

Obviously, many variations of the present invention are possible within the scope of these teachings. For example, rulings of other circular types may be used in place of the spiral rulings described; again, the entire faces of the instruments need not be covered with rulings. For this reason, therefore, no limitation to the exact examples given is intended.

I claim:

1. In an instrument dial having a face with an indicator marking thereon, and a hand adapted for relative motion over the face to indicate the marking, the improvement comprising: a part of the face comprising a spiral optical diffraction grating and a part of the hand being superimposed on the spiral optical diffraction grating, the face

comprising a plurality of spiral optical diffraction gratings, the hand having a path of travel over plural of said gratings in succession, and plural of said succession of gratings being of substantially uniform width and having different ruling characteristics.

2. In an instrument dial as recited in claim 1, the part of the hand superimposed on said succession of gratings being of a width less than the said substantially uniform width of a grating.

3. In an instrument dial, including a face, and a dial pointer adapted for relative motion over the face and having a length and width adapted to obscure a portion of the face, the improvement comprising: said face portion comprising a plurality of spiral optical diffraction gratings of substantially uniform diameter, said diameter being less than twice the said width of the dial pointer.

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