United States Patent [19]

Novak

[11] **3,876,304**

[45] **Apr. 8, 1975**

[54] **PHASE RETICLE DESIGN**

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[22] Filed: **Sept. 6, 1973**

[21] Appl. No.: **394,863**

[52] **U.S. Cl.** ..... **356/71**; 356/169; 250/237; 350/162 SF

[51] **Int. Cl.** **G06k 9/08**

[58] **Field of Search** ..... 356/71, 239, 69; 250/556, 250/557, 237 G, 237; 350/205, 162 SF

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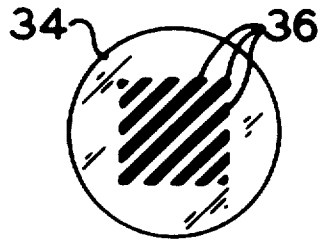
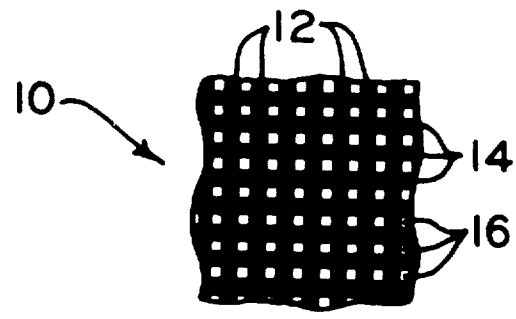
Assistant Examiner—Paul K. Godwin
Attorney, Agent, or Firm—Oldham & Oldham Co.

[57] **ABSTRACT**

Disclosed is a reticle assembly readily adaptable for use in radiation sensitive paper security validation apparatus. A transparent lens containing thereon a plurality of evenly spaced parallel reticle lines comprises the assembly. The reticle lines are of such a nature that when the reticle assembly and the paper security to be validated are placed in close operative positional relationship the reticle lines diagonally transverse the lines of the cross-hatched grid pattern contained on the paper security being validated.

9 Claims, 10 Drawing Figures





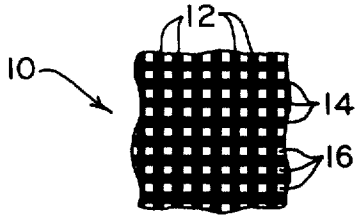


FIG-1

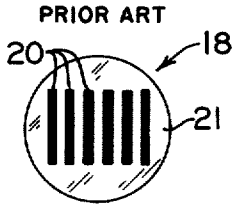


FIG-2

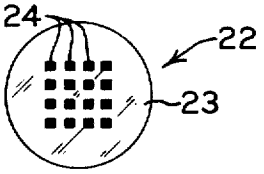


FIG-3

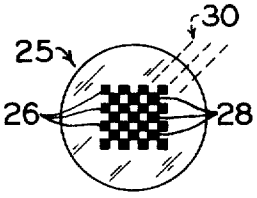


FIG-4

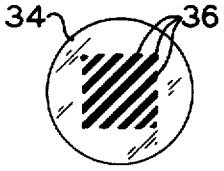


FIG-5

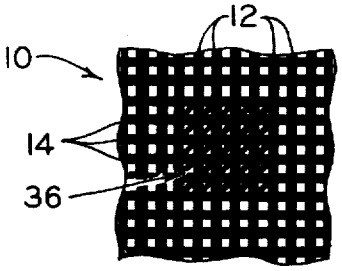


FIG-6a

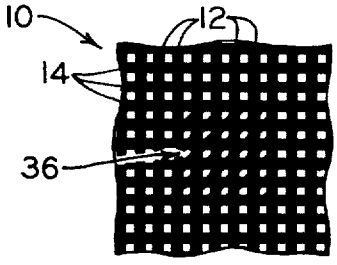


FIG-6b

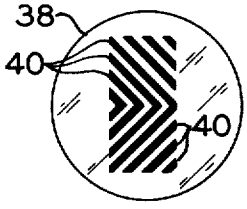


FIG-7

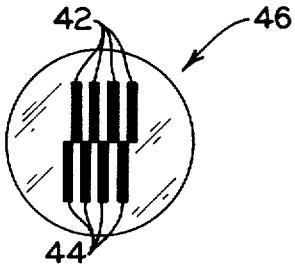


FIG-8

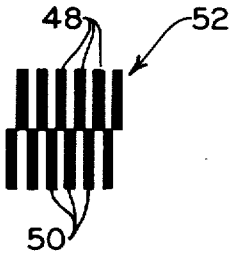


FIG-9

PHASE RETICLE DESIGN

BACKGROUND OF THE INVENTION

Heretofore various types of apparatus have been known which provide means for determining the authenticity of paper securities. Such apparatus generally utilize a photoelectric technique to operate upon a preselected area of the paper security and, depending upon the results of the authenticity tests performed on this particular area, thereby determine the authenticity of the entire paper. In particular, apparatus for validating paper money generally test the sets of parallel printed lines behind the portrait thereon. This test is accomplished by utilizing a reticle assembly having a lined pattern similar to either the horizontal or vertical lined pattern in the portrait background. The positional relationship between the reticle and the paper money is augmented while light energy is passed through the paper money and reticle; the light energy so passed being detected by a photocell or other detector. The relative movement between the reticle and the portrait background causes alignment and misalignment of the lines which allow an accurate measurement to be made of the authenticity of the background of the currency.

A serious drawback of the type of reticle just described has become apparent. This type of reticle only recognizes and authenticates one set of lines, either the vertical or the horizontal, existing in the cross-hatched pattern of the portrait background. Indeed, if a reticle of the type now in use contained only vertical lines it would be unaffected by the absence of horizontal lines in the portrait background of the paper being validated. This problem has become quite serious since photocopy equipment is now available which can reproduce the minute lines present in the portrait background of paper currency. However, it has been noted that such photocopy equipment is generally capable of only accurately reproducing the extremely fine lines of the portrait background in either the horizontal or vertical direction but not both directions. Consequently, it has become necessary to produce a reticle which is capable of testing both the horizontal and vertical lines present on paper securities.

It is therefore an object of the instant invention to present an improved reticle readily adaptable for use in radiation sensitive paper security validation equipment which simultaneously tests the validity of both the horizontal and vertical lines present on paper securities.

A further object of the invention is to present an improved reticle which is substantially insensitive to horizontal or vertical misalignment of the paper security with relation to the reticle.

Yet another object of the invention is to present an improved reticle which is simplistic in design, readily adaptable for use with presently existing validation systems, highly accurate, and more capable of determining the authenticity of paper securities than presently existing reticles.

These objects and other objects which will become apparent as the detailed description is presented are achieved by a reticle assembly comprising a substantially transparent lens and a plurality of apertures positioned upon the lens in such a manner that when the reticle is operatively positioned with respect to the cross-hatched pattern to be validated the apertures of the reticle pass transversely to the two sets of lines of the cross-hatched pattern.

For a full understanding of the techniques and apparatus of the invention reference should be had to the detailed description and accompanying drawings wherein:

FIG. **1** is an exploded view of a typical grid or cross-hatched pattern;

FIG. **2** is a prior art showing of a reticle assembly;

FIG. **3** shows a reticle assembly having a reticle pattern which is substantially a photonegative of the grid pattern of FIG. **1**;

FIG. **4** shows a reticle assembly wherein the reticle pattern comprises diagonally related boxes;

FIG. **5** shows a diagonal reticle according to the teachings of the invention;

FIG. **6**, comprising FIGS. **6***a* and **6***b*, show the operational technique of the reticle assembly according to the teachings of the invention;

FIG. **7** is a slight variation on the theme of the instant invention comprising two sets of phase reticle elements;

FIG. **8** is a slight variation on the theme of the invention wherein the apertures of the reticle are phase shifted; and

FIG. **9** is a showing of a grid which may be validated with the reticle of FIG. **8**.

Referring now to the drawings and more particularly FIG. **1**, a cross-hatched or grid pattern similar to that which is characteristically present on many paper securities is shown. This pattern is designated generally by the numeral **10** and is achieved by the intersection of a plurality of dark vertical lines **12** with a second plurality of dark horizontal lines **14**. The intersections of these lines result in the creation of the plurality of light boxes **16**. Although the grid pattern **10** is shown in FIG. **1** to have the spacing of the vertical lines **12** equivalent to the spacing of the horizontal lines **14** and the thickness of said lines to be equivalent to the spacing therebetween, such need not be the case. Indeed, the spacing of the vertical lines **12** might be different from that of the horizontal lines **14** and the thicknesses thereof may be substantially less than the spacings therebetween. The boxes **16** would then be rectangular in shape as is characteristic of many paper currencies. It will of course be understood that the grid pattern **10** of FIG. **1** may have any of numerous characteristics and still be tested by the techniques and apparatus of the invention.

A prior art reticle assembly **18** is shown in FIG. **2** to be characterized by the presence of a plurality of equally spaced parallel dark reticle lines **20**, present upon a transparent lens **21**. Consistent with prior art teachings, these lines **20** are present in the same number per inch ratio as are the evenly spaced parallel dark lines **12** of the grid pattern **10**. Of course, the spacing of the lines **20** could similarly be consistent with the spacing of the lines **14**. General paper security validation techniques teach that the grid pattern **10** and the reticle assembly **18** are placed in a close positional relationship such that the lines **20** are substantially parallel to and opposite the lines **12**. A light source is caused to shine upon the grid pattern **10** passing through the boxes **16**, through portions of the lens **21**, and onto a photo or solar cell which emits signals indicative of the amount of light incident thereon. As the positional relationship between the reticle assembly **18** and the grid pattern **10** is augmented in a direction perpendicular to the direction of the lines **20** and **12** the boxes **16** are al-

ternately opened and closed as to light passage as the lines **20** fall into and out of alignment with the lines **12.** As the light passage through the boxes **16** is gradually increased and decreased resultant signals are emitted from the photocell indicative of the degree of correlation between the spacing and thickness of the lines **20** and the lines **12.** It should be noted however that the magnitude of fluctuation of the signal emitted by the photocell would not be significantly affected if the lines **14** of the grid **10** were absent. Indeed, the applicants have found that prior art reticles used in conjunction with validation apparatus similar to that described in U.S. Pat. No. 3,457,421 could possibly allow a photocopy of paper security which only accurately contained the lines **12** of the cross-hatched pattern **10** to pass the validation test.

The applicants have found that the simplest approach to developing a reticle which tests both the horizontal and vertical lines of the grid pattern is to characterize the reticle assembly with the presence of the negative of that pattern. FIG. **3** illustrates a reticle assembly **22** containing upon the lens **23** thereof a plurality of dark boxes **24** of similar size and positioning as the light boxes **16** of the pattern **10.** It can be seen that if the reticle **22** and the pattern **10** are placed in close positional relationship with each other such that the dark boxes **24** are aligned with the light boxes **16** then a validation test similar to that described hereinabove may be performed. Here it can be seen that if the vertical lines **12** are missing in the cross-hatched pattern **10** then a constant level of light emission from the light source of the photocell will be experienced and a resultant voltage indicative of this condition will be evidenced at the output of the photocell. In other words, with the set of lines **14** missing there will never be a total blackout or prevention of light passage to the photocell, and consequently the fluctuation of the output signal of the photocell will not be sufficient to indicate authenticity.

It should be noted however that the reticle **22** is quite sensitive to misalignments between the reticle **22** and the cross-hatched pattern **10.** Particularly, if the reticle **22** and the pattern **10** are positioned such that the dark boxes **24** are opposite the lines **14** and if relative movement between the reticle assembly **22** and the pattern **10** is caused to be made parallel to the lines **14** then no fluctuation of light passage or voltage output from the photocell will be realized since the boxes **24** will never intercept the boxes **16.** It should be seen then that the attributes of the reticle assembly **22** might be defeated by a very slight misalignment.

To circumvent the misalignment problem present with the reticle assembly **22,** the reticle assembly **25** of FIG. **4** was developed. As can be seen, this reticle comprises a first plurality of rows of dark reticle boxes **26** similar in size and spaced relationships as the light boxes **16.** The reticle assembly **25** further contains a second plurality of rows of dark reticle boxes **28** which are also of substantially the same size and spaced relationship as the boxes **16.** However, it should be noted that the group of boxes **26** and the group of boxes **28** are offset from each other a distance equivalent to the height and width of one of the boxes. In other words, there exists a phase difference relationship between the boxes **28** and the boxes **26.** This offset of phase shift of the groups of boxes alleviates the misalignment problem. It can be seen that when the reticle assembly **25** is brought into close positional relationship with the grid pattern **10** in such a manner that the boxes **26** are misaligned with the boxes **16** then the boxes **28** will be aligned therewith. Similarly, if the boxes **28** are misaligned with the boxes **16** then the boxes **26** will be aligned therewith. It should be observed that as the boxes **26** come into a greater degree of alignment with the boxes **16** the boxes **28** come into a lesser degree of alignment so that the total degree of alignment realized by the reticle assembly **25** will be constant.

With the reticle of FIG. **4** it should become readily apparent that if either of the sets of lines **12** or **14** is absent from the cross-hatch pattern **10** then no validation signal will be generated when the reticle is placed in operative positional engagement therewith.

It can be observed that the boxes **26** and **28** of the reticle assembly **25** lie along the diagonal lines **30.** Upon the basis of this observation, the applicants recognized that a reticle having diagonally spaced lines thereon would achieve the purpose of testing for the presence of both the lines **12** and the lines **14** of the pattern **10** while alleviating the misalignment problem.

A phase reticle according to the teachings of the instant invention is shown in FIG. **5.** The reticle **34** is characterized by the presence of the dark parallel evenly spaced lines **36.** These diagonal lines **36** define apertures therebetween and are at the same angle and spacing as would be the lines passing through diagonally opposite corners of the boxes **16** of the pattern **10.** Of course, if the spacing of the lines **12** were different from the spacing of the lines **14** then the diagonal reticle lines **36** of the reticle assembly **34** would not be at a 45° angle but would be augmented therefrom and spaced in accordance with the particular characteristics of the grid pattern to be validated.

FIG. **6,** comprising FIGS. **6***a* and **6***b*, shows the validation technique to be used with the reticle assembly **34.** The reticle **34** is brought into close positional relationship with the pattern **10** and that relationship is augmented by relative motion between the two parallel to the lines **14.** FIG. **6***a* shows the positional relationship between the reticle **34** and the pattern **10** which would allow the least light to pass to the photocell while FIG. **6***b* shows that positional relationship allowing the most light to pass thereto. As was described hereinabove, and as is well know to those skilled in the art, the degree and number of light passage fluctuations experienced during a test result in characteristic signal output from the photocell which indicate the validity or invalidity of the material being sensed. Indeed, the apparatus described in U.S. Pat. No. 3,457,421 would be readiliy conducive to operation with the disclosed phase reticle with only a slight change being required in a DC restorer which would compensate for a constant DC level resulting from the photocell due to the fact that the diagonal reticle never completely cuts off light transmission thereto. The voltage fluctuations, both as to number and amplitude, which would be experienced at the output of the photocell would be readily adaptable for use by the associated circuitry described in that patent.

It should of course be noted that the phase reticle may be varied in many respects and that the reticle lines **36** may be of any numerous characteristics, those characteristics being determined by the particular substance to be validated. In particular, the thickness of the lines **36,** the actual number to be placed upon the reticle assembly **34,** and the specific positioning of the

lines 36 may readily be varied with due consideration given to the quality of the material being validated and the sensitivity of the circuitry processing the photocell signals.

FIG. 7 shows a reticle assembly which slightly varies on the theme of the instant invention. In understanding the slight variation it will be appreciated that the basic concept of presenting a validation reticle which tests both the horizontal and vertical lines in the grid pattern is to guarantee that the elements of the reticle are of such a nature that when the positional relationship between the reticle and grid pattern is operatively changed, positional relationship changes occur between the elements of the reticle and both sets of lines 12 and 14 comprising the grid pattern. When the relative motion between the reticle and the grid pattern is to be parallel to one of the sets of lines comprising the grid pattern then it is incumbent that the reticle element be angled with respect to both sets of lines. The maximum degree of fluctuation to be achieved using a reticle assembly having angled reticle elements would of course be realized when the reticle elements diagonally transverse the sets of lines comprising the grid pattern.

FIG. 7 shows a reticle assembly 38 according to the teachings of the invention wherein the reticle elements comprise a plurality of dovetails 40. Each of the dovetails 40 is comprised of two elements, one element being diagonally transversed with the elements of the grid pattern along one diagonal, and the other element along the other diagonal. Relative motion between the reticle assembly 38 and the grid pattern 10 parallel to either of the lines 12 or 14 will produce the fluctuating output signals necessary to control the validity device with which the reticle assembly 38 is associated.

A slight variation on a theme of the apparatus of the instant invention is shown in FIG. 8. Here a phase reticle 46 is shown having two groups of dark parallel lines 42 and 44 present thereon. The lines 42 and the lines 44 define apertures therebetween through which light may pass during the validation exercise. As can be seen, the lines 42 and the lines 44 are phase shifted with respect to each other by 180°. The reticle 46 is contemplated to be used in validating a grid comprised of two sets of vertical lines 48 and 50 as shown in FIG. 9. It can be seen the relative horizontal movement between the reticle 46 and the grid pattern 52 would result in alternating on-off signals from the validating apparatus. If one of the sets of lines 48 or 50 were missing such that the grid 52 comprised merely a plurality of parallel vertical lines then there would be no signal output when the reticle 46 were brought into operative engagement with the grid 52 since the phase between the lines 42 and 44 of the reticle 46 would guarantee a constant degree of alignment between the apertures of the reticle 46 and the lines of the grid 52. Thus it can be seen that the phase shifted relationship between the apertures of the reticle 46 guarantees that validation of both sets of lines 48 and 50 comprising the grid pattern 52 will be achieved. Again, as was presented in the embodiments hereinabove, it is the aggregate signal achieved from the various phase shifted apertures of the reticle which culminates in a signal indicative of the presence or absence of element of the grid.

It should be appreciated that the improved reticle and the variations thereof which have been disclosed herein serve the unique purpose of testing the spacing and characteristics of the grid patterns so commonly contained on security instruments and paper. But for the unique arrangement of the reticle elements upon the lens of the reticle assembly, the reticle assembly of the instant invention is quite similar in nature to those presently in the art. Particularly, it should be understood that in normal operation a mask would be associated with the reticle assembly to assure that the effective portion of the assembly is that portion of the lens which contains thereon the angled reticle elements. Further, the general materials and techniques utilized in constructing reticle assemblies now available in the art are readily conducive to the construction and assembly of the improved reticle of the instant invention.

It should now be understood that the objects of the invention have been achieved by the techniques and apparatus of the phase reticle presented herein and described in detail. While in accordance with the Patent Statutes only the best known and preferred embodiment of the invention has been disclosed, it is to be understood that the invention is not limited thereto or thereby. Consequently, for an appreciation of the true scope of the invention reference should be had to the accompanying claims.

What is claimed is:

1. A reticle assembly to be placed in close positional relationship with a cross-hatched pattern created by the intersection of two sets of lines on a material to be authenticated such that relative positional changes between the reticle and the cross-hatched pattern result in fluctuations in the amount of light passing therethrough, comprising:

a substantially transparent window; and

a plurality of apertures positioned upon the window in spaced relationship according to the spacing of diagonals through the intersection of the two sets of lines forming the cross-hatched pattern such that when the reticle is operationally positioned with respect to the cross-hatched pattern the apertures of the reticle pass transversely to the two sets of lines thereof.

2. The reticle assembly as recited in claim 1 wherein the plurality of apertures positioned upon the window are parallel with respect to each other.

3. The reticle assemble as recited in claim 1 wherein the plurality of apertures positioned upon the lens are equally spaced upon the lens with respect to each other.

4. The reticle assembly as recited in claim 1 wherein the plurality of apertures positioned upon the window are, when the reticle is in operative positional relationship with the cross-hatched pattern, diagonally transverse to the intersection points of the two sets of lines of the cross-hatched pattern.

5. The reticle assembly as recited in claim 4 wherein the plurality of apertures positioned upon the window are equally spaced with relation to each other such that each intersection point of the cross-hatched pattern directly opposite the reticle is transversed by one of the lines on the window.

6. A reticle assembly to be placed in close positional relationship with a multi-lined grid pattern to determine the validity of the pattern, comprising a transparent window and a plurality of reticle elements upon the window of such a nature that when the reticle assembly is operatively within a close positional relationship with

the grid pattern the reticle elements are obliquely angled with respect to the lines of the pattern.

7. The reticle assembly as recited in claim 6 wherein the portion of the window not containing the plurality of reticle elements is masked.

8. The reticle assembly as recited in claim 6 wherein the reticle elements are so angled that when the reticle assembly is operatively positioned with respect to the grid pattern the reticle elements diagonally transverse the points of intersection of the lines of the pattern.

9. The reticle assembly as recited in claim 6 wherein the reticle elements comprise a plurality of evenly spaced parallel apertures.

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