

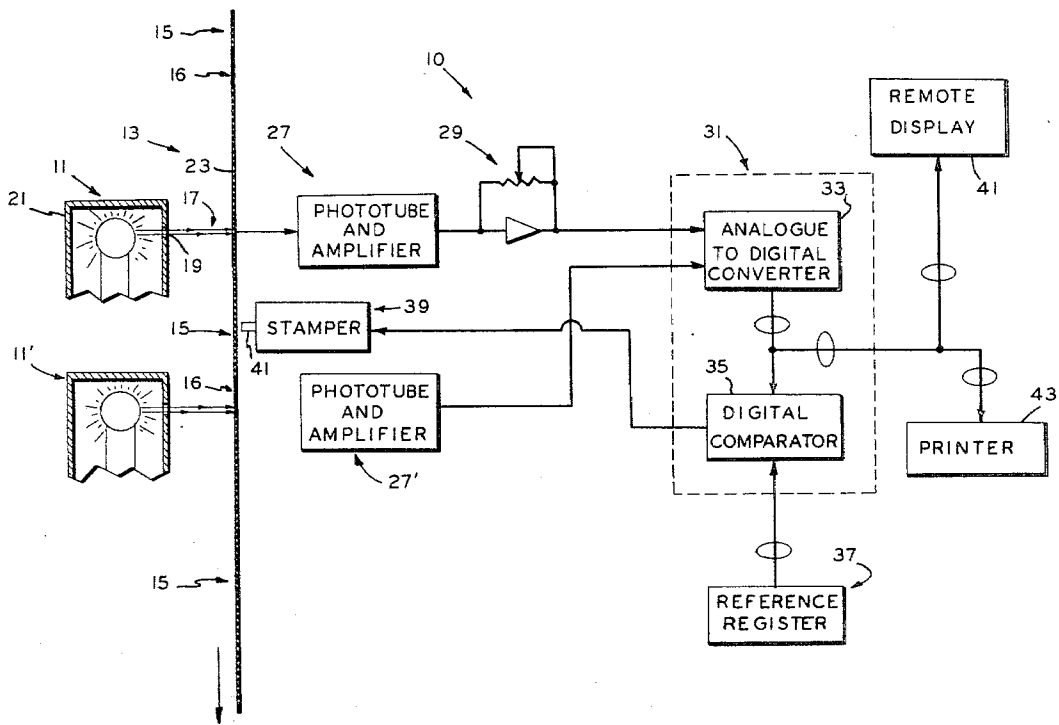
[54] APPARATUS FOR MEASURING AND MARKING APERTURE MASKS
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[73] Assignee: GTE Sylvania Incorporated, Seneca Falls, N.Y.
[22] Filed: June 24, 1971
[21] Appl. No.: 156,388
[52] U.S. Cl. 356/156, 356/159, 356/168, 250/219 DF
[51] Int. Cl. G01b 11/00, G01b 11/04, G01b 11/24
[58] Field of Search 250/219 DF; 356/201, 356/202, 168

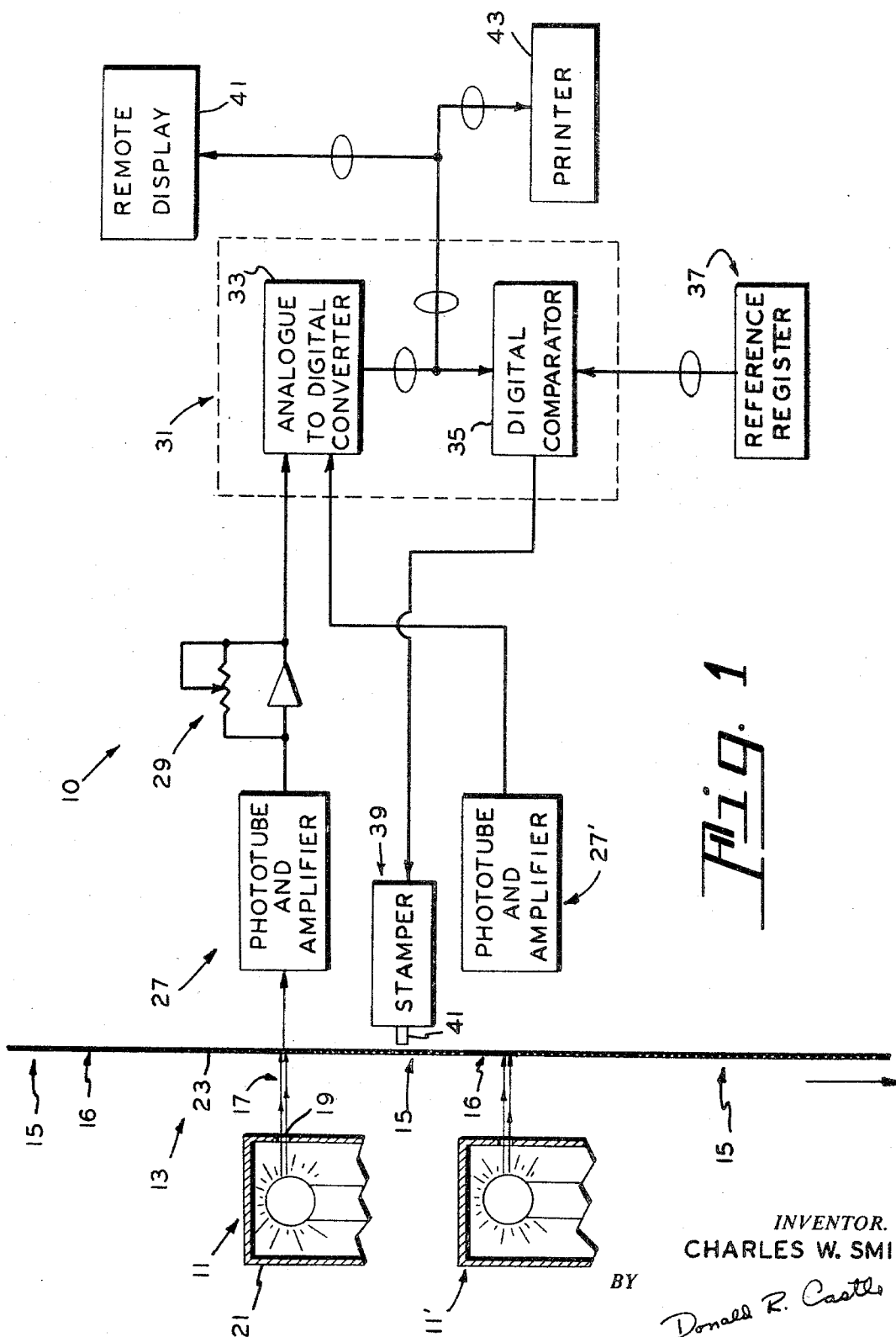
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[57] ABSTRACT
An apparatus for measuring and marking aperture masks for color television cathode ray tubes according to hole size utilizing a light source positioned on one side of the mask and a light detection means positioned on the other side. Upon receiving the portion of light which passes through the mask, the light detection means converts the light to a first electrical signal and sends this signal to a comparing means, which simultaneously receives a second signal representative of the proper hole size designated for the mask from a selection means. Should the two signals compare favorably, a control signal is derived which actuates a marking means for consequently marking the measured mask. Should the two signals not compare, the measured mask is not marked and is therefore rejected.

12 Claims, 2 Drawing Figures





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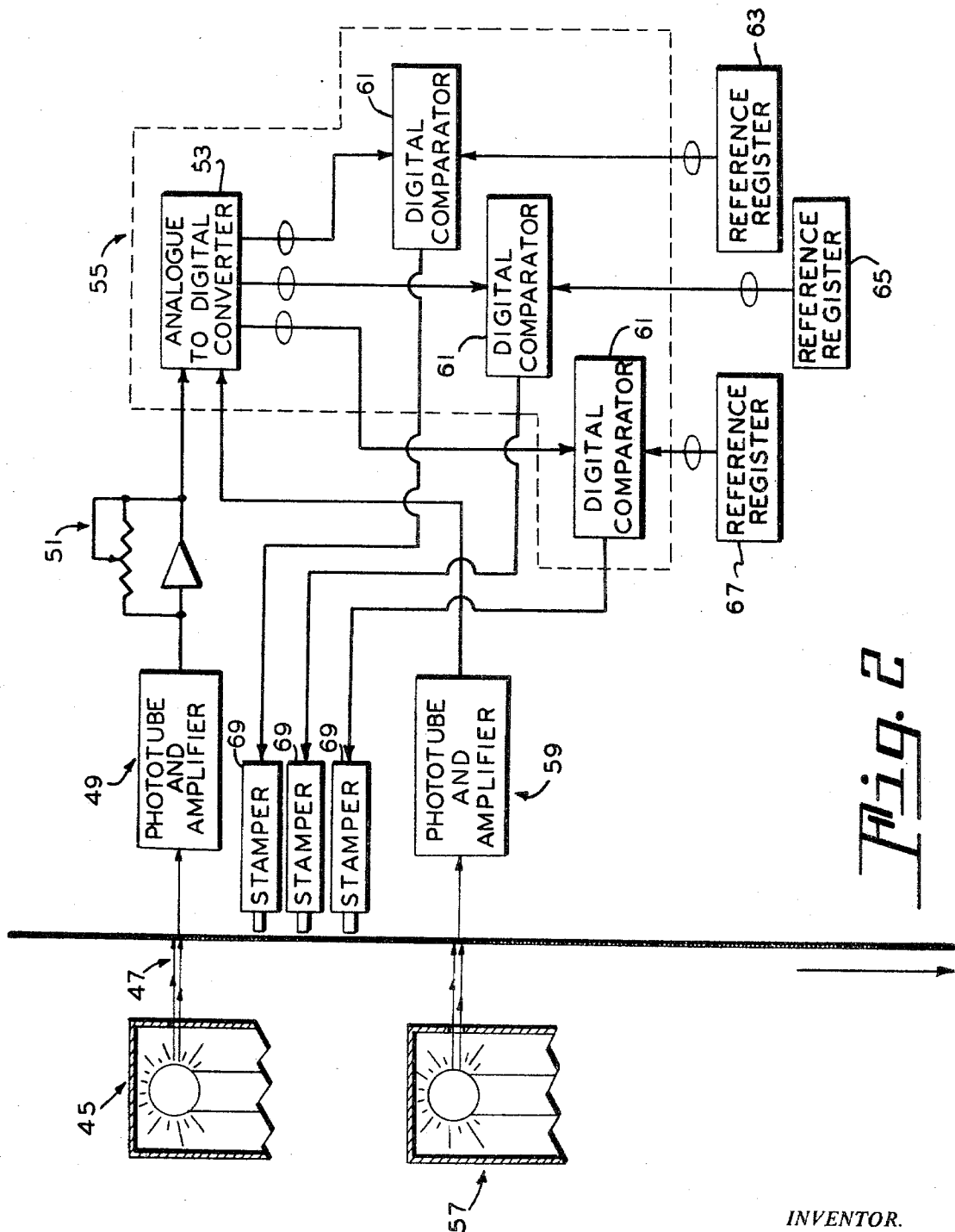


Fig. 2

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APPARATUS FOR MEASURING AND MARKING APERTURE MASKS

BACKGROUND OF THE INVENTION

This invention relates to color television cathode ray tube manufacturing and more particularly to methods for manufacturing the aperture mask which is an integral part of many tubes of this variety.

The conventional aperture mask found in most color television cathode ray tubes is positioned within the envelope of the tube in spaced relationship to an adjacent cathodoluminescent screen formed on the inner surface of the tube face panel. The primary reason for the mask is to insure that electron beams emitted from electron guns positioned in the neck of the tube strike the proper phosphor dots found in the cathodoluminescent screen to provide the correct color combinations while not allowing the electron beams to overlap and strike other dots.

Aperture masks, as described above, are made from sheets of very thin metal, usually steel, and contain thousands of very small apertures or holes through which the electron beams are passed before striking the phosphor dots. These holes are usually etched out of the metal through the employment of photographic and etching techniques standard in the industry. After photoprinting the hole pattern onto the mask surfaces, the etching solutions are sprayed on to remove the exposed areas. After etching the masks are still integral parts of a long metal strip or web. Individual masks are cut from this strip and formed to coincide with the internal portion of the cathode ray tube screen.

Typical example of the sizes of holes in aperture masks may range from 0.005 to 0.014 inch and have center to center spacings ranging from 0.02 to 0.03 inch depending on the overall size of the mask and corresponding picture tube.

It can be readily seen, therefore, that the sizes of these holes are critical in order that proper electron beam-phosphor dot combinations occur. To assure that these critical dimensions are maintained during the manufacture of these masks, various methods of inspection have been employed. One such method has been for a human inspector to examine the mask, utilizing some means of magnification. Not only has this method proven time consuming, but the possibility for human error is present. A further, more advanced, method of inspection has been to employ a moving frame having several reading heads which read various points on the masks as they move on the production line. While substantially eliminating the human error possibility, this method also requires undesirable time consumption, primarily because it is necessary to clamp each of these reading heads to the masks at these points, making it therefore impossible to measure every mask and still maintain the time standards as dictated by production requirements.

OBJECTS AND SUMMARY OF THE INVENTION

It is, therefore, an object of this invention to reduce the aforementioned disadvantages and to provide a unique apparatus for measuring and marking aperture masks according to hole size.

A further object of this invention is to provide an aperture mask hole size measuring and marking apparatus which is totally automatic in operation.

The foregoing objects are achieved in one aspect of the invention by a positioned light source emitting a light beam to a designated area on one side of an aperture mask. The portion of light passing through the mask is converted to a first electrical signal by a light detection means which sends this signal to a comparing means, where it is compared to a second electrical signal from a selection means. This second signal is representative of a hole size desirable for the aperture mask. Should the two signals compare favorably, a control signal is derived which in turn is sent to a marking unit which marks the mask. If the two signals fail to compare, no control signal results, and consequently the mask is not marked making it unacceptable for production.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic view of one embodiment of the present invention; and

FIG. 2 is a schematic view of another embodiment of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

For a better understanding of the present invention, together with other and further objects, advantages, and capabilities thereof, reference is made to the following disclosure and appended claims in connection with the above-described drawings.

With reference to the drawings, one embodiment of the present invention, apparatus 10, is shown in FIG. 1. A light source 11 is positioned on one side of a line of aperture masks 13 moving in the direction indicated. This line comprises an elongated strip of thin metal on which are located several uncut aperture masks 15 in succession, each bordered by non-translucent areas 16. At this stage the line has completed the etching step as previously described and is now proceeding to the cutting area when each mask is removed and formed prior to insertion into the cathode ray tube. A narrow light beam 17 leaves light source 11 through an opening 19 of a shield 21 striking surface 23 of the moving aperture mask line 13. The dimensions of this light beam, which are kept constant throughout the operation of apparatus 10, are such that it covers a grouping of several holes in the mask. As the line moves, beam 17 eventually strikes surface 23 for a full width of each mask.

The portion of light beam 17 which passes through the aperture mask line 13 is received by detection means 27 where it is converted to an electrical signal. Although other methods of obtaining this signal are possible, the method shown here comprises a phototube and amplifier circuit. The phototube converts the incoming incident light to an electrical signal which is coupled to the amplifier and amplified. An output of detection means 27 is coupled to a calibration means illustrated as an operational amplifier 29 which has a variable feedback for calibrating the apparatus.

The signal provided by detection means 27 is compared to a reference signal representative of the hole size desired for the mask being measured. Accordingly, the output of amplifier 29 is coupled to a comparing means 31 which also receives a reference signal from a selection means 37. In the preferred embodiment comparing means 31 comprises an analogue to digital (A/D) converter 33 for receiving the output signal

from amplifier 29 and a digital comparator 35 for receiving the resulting digital output signal from A/D converter 33 and a digital reference signal from selection means 37. Converter 33 may be a commercially available digital voltmeter which provides a visual read-out as well as the above-mentioned digital output signal. Digital comparator 35 can be one of several known comparator circuits.

In the preferred embodiment apparatus 10 reads a predetermined point or position on each mask as it passes before light source 11, for example, a point at the approximate center of each mask. To accomplish this, a second light source 11' and detection means 27' are positioned at a distance from light source 11 and detection means 27 approximately equal to one-half the width of the masks to be measured. When detection means 27' detects the leading non-translucent area 16 of the mask, it provides a signal to A/D converter 33 which causes A/D converter 33 to hold the last voltage level from amplifier 29 and provide a digital output signal representative of that voltage level to comparator 35. In doing so, it can be seen that each mask is measured at least once by apparatus 10. The digital output signal from A/D converter 33 can be in any suitable form such as a set of signals in binary notation, binary coded decimal (BCD) notation, or other suitable digital notation.

In the preferred embodiment selection means 37 is a reference register connected to digital comparator 35 and provides a digital reference signal thereto which is similar to the signal provided by converter 33. Reference register 37 can be a set of manually operable switches which selectively couple a voltage source to comparator 35 to provide a pre-selected signal representative of a given hole size desirable for the aperture mask. A plurality of leads from register 37 are utilized to couple the reference signal to comparator 35, and a plurality of leads couple A/D converter 33 to comparator 35. Both these connections are shown as a single line surrounded by an ellipse.

An output of comparing means 31 such as an output of digital comparator 35 is connected to a marking means 39 for coupling a control signal thereto. If the two digital signals fed to comparator 35 are equal, the resulting control signal provided by digital comparator 35 actuates marking means 39 to move a marking arm 41 forward to engage a non-translucent area of the measured mask. Having been marked, the mask is now acceptable for production. One typical method of marking the masks, as indicated in FIG. 1, comprises a stamper in which arm 41 moves to indent the area previously described with a numerical value. If the two signals compared by digital comparator 35 are not equal, stamper 39 is not actuated therefore leaving the measured mask unmarked and consequently unacceptable for further production.

While apparatus 10 serves to measure and mark each mask of the line of aperture masks 13, it can also be utilized to perform other functions. The signal from A/D converter 33 is tapped off to a remote display 41 and a printer 43. Display 41 can be positioned in the etching area of the production line and serve to indicate to the etching personnel whether to increase, decrease, or hold the pressure from the spray nozzles. Increasing or decreasing this pressure respectively increases or decreases the hole sizes of the mask line. Printer 43 can be utilized to keep a continual tabulation of hole sizes

for further reference. The connections to remote display 41 and printer 43 constitute a plurality of individual wires, as represented by designated ellipses.

Referring to FIG. 2, another embodiment of the apparatus of FIG. 1 is shown. Light source 45 provides light beam 47 of which a portion is detected by detection means 49 and converted to an electrical signal in a manner of operation similar to that previously explained in the description of FIG. 1. Calibration means 51 is used to calibrate the signal, which is fed A/D converter 53 of comparing means 55. In like manner, a second light source 57 and detection means 59 are used to provide converter 53 with a signal which causes the converter to hold the last voltage level from calibration means 51 and provide a digital output signal to each of the digital comparators 61. Comparators 61 each receive a digital signal from one of the selection means 63, 65, or 67, each of these selection means being adjusted to provide a different signal indicative of different hole sizes acceptable for production. The comparators 61 then compare the signal they receive with the common signal received from converter 53. If the two signals compare favorably in one of the comparators, the marking means 69 coupled to that comparator is activated. If all three fail to produce a match, the mask again is unmarked, and therefore rejected. The primary purpose of this embodiment is to subdivide the ranges of acceptable values and consequently give more accurate markings to each measured mask.

As in apparatus 10 of FIG. 1, marking means 69 can each comprise a stamper in which case the non-translucent area is indented with a range value in which the measured values are determined to lie. Likewise selection means 63, 65, and 67 can each comprise a reference register having a plurality of manually operable switches, each being coupled to a corresponding potential source.

Thus there has been illustrated and described apparatus for measuring and marking individual aperture masks for cathode ray tubes according to hole sizes of the masks. The apparatus is totally automatic in operation thereby eliminating the possibility of human error. Further, the apparatus is adapted for measuring and marking every aperture mask on the moving production line, thereby enhancing the art of producing cathode ray tubes which utilize these masks.

While there have been shown and described what are at present considered the preferred embodiments of the invention, it will be obvious to those skilled in the art that various changes and modifications may be made therein without departing from the scope of the invention as defined by the appended claims.

I claim:

1. Apparatus for measuring and marking individual aperture masks for cathode ray tubes according to hole sizes of said aperture masks, said apparatus comprising:
 - first and second light sources positioned on one side of said aperture mask, each of said light sources adapted for providing a light beam to said side of said mask at a pre-established position on said mask;
 - first and second light detection means positioned on the opposite side of said aperture mask from said first and second light sources, said first light detection means adapted for providing a first electrical signal representative of that portion of the light beam from said first light source which passes

through said holes of said aperture mask, said second light detection means adapted for providing a second electrical signal when the light beam from said second light source strikes a non-translucent area of said aperture mask;

selection means for pre-selecting a third electrical signal representative of a given hole size desirable for said aperture mask;
means for comparing said first and third electrical signals and deriving a control signal upon the occurrence of said second electrical signal; and
means for marking said aperture mask in accordance with said control signal from said comparing means.

2. The apparatus according to claim 1 in which each of said light detection means comprises a phototube and amplifier circuit.

3. The apparatus according to claim 1 in which said selection means comprises a switching means selectively coupling a potential source to said means for comparing said first and third signals.

4. The apparatus according to claim 1 in which said means for comparing said first and third electrical signals and deriving a control signal upon the occurrence of said second electrical signal comprises an analogue to digital converter for receiving said first and second electrical signals from said first and second light detection means, respectively, and for providing a digital signal therefrom, and a digital comparator connected to said converter for comparing said digital signal to said third electrical signal and deriving said control signal.

5. The apparatus according to claim 1 in which said means for marking said aperture mask comprises a stamping member adapted to stamp a preselected area of said aperture mask, said stamping member being actuated by said control signal from said means for comparing said first and third signals.

6. The apparatus according to claim 4 in which said selection means comprises a switching means selectively coupling a potential source to said digital comparator of said means for comparing said first and third electrical signals.

7. An apparatus for measuring and marking individual aperture masks for cathode ray tubes according to hole sizes of said aperture masks, said apparatus comprising:

a light source positioned on one side of said aperture mask for providing a light beam to said side of said mask at a pre-established position on said mask;

a light detection means positioned on the opposite side of said aperture mask for providing a first electrical signal representative of that portion of said light beam which passes through said holes of said aperture mask at said pre-established position on said mask;

selection means for preselecting a plurality of second electrical signals representative of a plurality of hole sizes desirable for said aperture mask;
means for comparing said first electrical signal to said plurality of second electrical signals and deriving a control signal; and
means for marking said aperture mask in accordance with said control signal from said means for comparing said first and second electrical signals.

8. The apparatus according to claim 7 in which said selection means comprises a plurality of switches, each of said switches selectively coupling a potential source to said means for comparing said first and second electrical signals.

9. The apparatus according to claim 7 in which said light detection means comprises a phototube and amplifier circuit to convert said portion of said light beam to said first electrical signal.

10. The apparatus according to claim 7 in which said means for comparing said first electrical signal with said plurality of second electrical signals and deriving a control signal comprises an analogue to digital converter for receiving said first electrical signal from said light detection means and for providing a digital signal to each of a plurality of digital comparators, each of said digital comparators adapted for comparing said digital signal to a plurality of said second electrical signals from said selection means and deriving said control signal.

11. The apparatus according to claim 7 in which said means for marking said aperture mask comprises a plurality of stamping members, each of said stamping members adapted for stamping a pre-selected area of said aperture mask and being actuated by said control signal from said means for comparing said first and second electrical signals.

12. The apparatus according to claim 10 in which said selection means comprises a plurality of switching means each of said switching means selectively coupling a potential source to one of said digital comparators of said means for comparing said first and second electrical signals.

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