

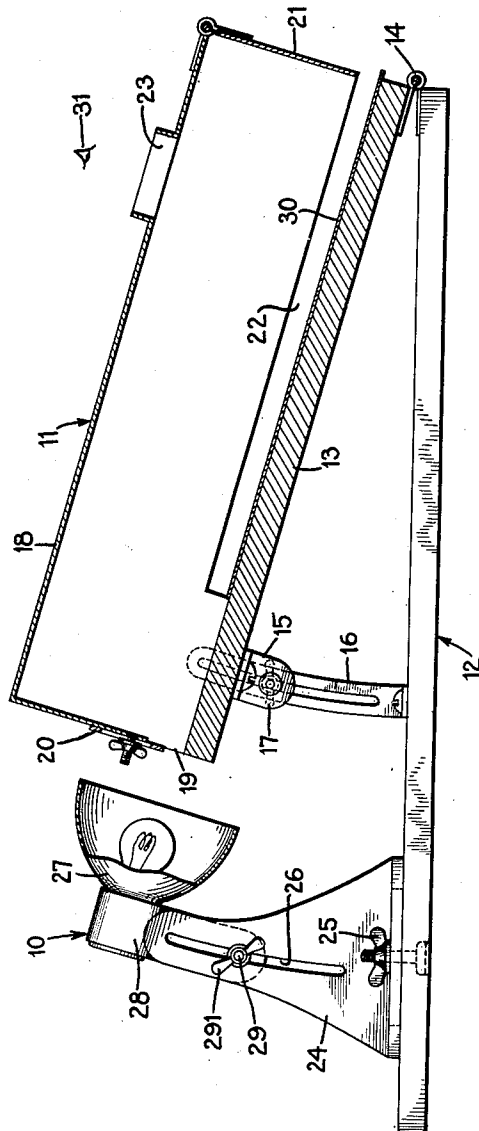
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OPTICAL TESTING

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OPTICAL TESTING

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9 Claims. (Cl. 88-14)

This invention relates to apparatus for inspecting the surface of various materials and more particularly for determination of the quality and character of such surface.

Our invention finds special utility in observing defects such as wrinkles, cockles, embossings, roughness, grain or fuzz on various materials such as paper, cardboard and the like.

It has been common practice heretofore in the art of inspecting paper to simply hold the paper up to the light and look along its surface at a suitable angle towards the light. This practice has been in almost constant use for a number of years and is reasonably satisfactory where the inspectors are highly skilled persons. However, in addition to requiring skill and involving the human factor in properly presenting the surface to the light a bad feature of the common practice is that it requires the light to shine directly in the eyes of the inspector and, therefore, causes considerable glare and eye strain. By our invention controlled beams of light are caused to shine substantially parallel to the surface to be inspected and the material is viewed by looking down in a direction substantially perpendicular to said surface. By this method glare and eye-strain are eliminated and the surface quality may be readily determined at a glance by an unskilled worker.

Further objects and advantages will be more apparent from the following detailed description of one embodiment of an apparatus for carrying out the invention.

The figure in the drawing is a longitudinal, elevational view of an embodiment of the inspecting apparatus partly in section.

In this device a suitable source of light 10 and a housing 11 are mounted adjacent each other on a base 12. The housing consists of a light impervious bottom 13 hinged to the base at one end 14 and supported near its other end in adjustable relation with said base by the depending bracket 15 which is secured to bottom 13 and adjustably connected to a bracket 16 by a thumb screw 17. Bracket 16, in turn, is secured to the base. Overlying the bottom member 13 is a cover 18 of suitable light impervious material and provided at its end with a slot 19 to admit light. Said slot may be adjusted in size by a sliding panel 20. The forward end of said housing is provided with a hinged flap 21, which terminates a slight distance above the bottom 13, and the sides of the housing are preferably slotted as at 22 to provide for the admission of material to be inspected.

At the top of the housing and near the forward end of the inspecting device there is provided an opening 23 through which the inspector may view the material.

The adjustable light source 10 may consist of a standard 24 clamped to the base by the bolt and wing nut 25 and having an arcuate, substantially vertical slot 26 therein whose center of curvature is at the hinge 14. A suitable reflector and bulb 27 or other light source is mounted in a bracket 28 carrying a bolt 29 adapted to cooperate with the slot 26. A wing nut or thumb screw 291 may be used to hold the bolt at any desired point in the slot so that the bracket and standard will be clamped together. An assembly is thus provided by which the light source may be raised or lowered to conform with the angle of elevation of the housing and may also be rotated about the bolt 29 to provide for tilting the light either upwardly or downwardly.

In the preferred embodiment of the apparatus, light is directed from the source 27 through the slot 19 in a direction substantially parallel to the surface of the sheet of paper 30. The inspector places his eye at about the point indicated at 31 and looks down on the surface of said paper in a direction substantially perpendicular thereto. The opening 23 may, if desired, be provided with a magnifying device, such as a lens, to more clearly bring out the imperfections, but this is not necessary since even such small particles as fuzz on the surface of the paper may be seen at a glance. The device is shown tilted at a small angle to the horizontal. This is primarily for the purpose of making it easier for a person standing or sitting beside the apparatus to view the material therein from a comfortable position. Any convenient angle may be used, or the testing apparatus may be substantially parallel with the base upon which it rests or perpendicular thereto, so long as light is admitted in the proper relation to the surface of the sheet under inspection. By the use of a reflector concentrating the light to a reasonable degree and a housing shielding this light from the operator, no glare reaches the eye of the observer. The light may be directed on the paper at a very small angle therewith provided this is not sufficient to produce reflection and resultant glare. The best results, however, are obtained when the light shines substantially parallel with the surface of the material.

We do not wish to be limited by any theory of operation because the result is clear that even

such small particles as fuzz on the paper surface show up distinctly and can be readily seen. It may be that fibres extending upwardly from the paper surface cause shadows to be cast which can be very easily seen. It is quite clear that this will be the case with relatively large projecting imperfections. Fuzz, of course, will ordinarily not extend perpendicularly from the paper, but will be arranged at somewhat of an angle determined by the relative slippage in the formation of the sheet so that it is probable that by directing the light parallel to the paper and keeping reflection at a minimum these small projections and other imperfections are selectively illuminated in preference to the main surface of the paper.

By our invention materials may be inserted through the slot in the housing and various imperfections on the surface thereof can be readily seen at a glance. It does not require the skilled observer as is necessary in manually holding the paper toward the light at exactly the correct angle. By the arrangement of a slot 22 and a flap 21 as illustrated in the drawing, a continuous sheet may be passed through the housing and stopped from time to time for inspection. It is also possible to inspect a sheet much larger than the area of the panel 13 by moving the sheet around to bring the desired portions thereof within the range of vision.

The use of the apparatus is not limited to inspecting paper surfaces, but may be applied to any other materials such as fabrics, metal, wood and various coated surfaces where qualitative determination of the character of such surface is desired. In analyzing relatively thick materials it will be desirable to raise the panel 20 and thus increase the size of the slot 19.

Various modifications may be made, and will readily suggest themselves, in the apparatus for carrying out the principles of the invention. For example, the apparatus may be constructed without the various adjustment features and with the parts in fixed relation when the device is to be used with materials of uniform thickness. The provision of a variable light source, however, is very helpful where the material to be inspected varies considerably in thickness. The light source might be located within the housing 18, if desired, in such a way as to cast its rays substantially along the surface of the sheet being inspected and without being visible directly from the opening 23. Numerous other changes will suggest themselves to persons skilled in the art.

The terms and expressions which we have employed are used as terms of description and not of limitation, and we have no intention, in the use of such terms and expressions, of excluding any equivalents of the features shown and described or portions thereof, but recognize that various modifications are possible within the scope of the invention claimed.

What we claim is:

1. Apparatus for inspecting material having a relatively flat surface comprising, supporting means for said material, means for directing light in only one direction along said surface and substantially parallel thereto, means for varying the angle at which the light strikes said surface, and means for shielding said surface from other light sources but enabling said surface to be observed in a direction transverse to said light.

2. Apparatus for inspecting material having a relatively flat surface comprising, supporting

means for said material, means for directing a controlled light beam along said surface and substantially parallel thereto, means for varying the angle at which the light strikes said surface, and means for shielding said surface from other light sources but enabling said surface to be observed in a direction transverse to said controlled light beam.

3. In a device for inspecting material having a relatively flat surface, means for supporting said material, a light source, said light source and said supporting means being adjustable relative to each other, means for directing light from said source along and substantially parallel to the surface of said material, and means for shielding said surface from other light sources but enabling observation of said surface in a direction substantially transverse to said light.

4. In a device for inspecting the surfaces of paper and like materials, a relatively flat support for such material, a light source, a housing overlying said support and so constructed and arranged as to admit light from said source in a direction substantially parallel to said material, said housing having an opening in its top through which the surface may be inspected, means for adjusting said light source relative to said support and means for regulating the amount of light admitted to said housing.

5. In a device for inspecting the surfaces of paper and like materials, a relatively flat support for such material, a light source, and a housing enclosing said support and so constructed and arranged as to admit light from said source in a direction substantially parallel to said material and to exclude light from other sources, said housing having an opening in the side to facilitate insertion and removal of the material with relation to said support and having an opening in its top through which the surface may be inspected.

6. In a device for detecting imperfections in the surface of paper and the like, a support for the material to be inspected, a housing substantially covering said support, means for directing a beam of light along and substantially parallel to said supporting means in only one direction, and means for adjusting said support with respect to said directing means, said housing having an inspection opening in its top through which the surface of the material may be viewed.

7. In a device for detecting imperfections in the surface of paper and the like, a support, a housing attached to and substantially covering said support, means for directing a beam of light in only one direction along and substantially parallel to the upper surface of said supporting means, and means for adjusting said directing means with respect to said support, said housing having an inspection opening in its top through which the surface of the material may be viewed.

8. Inspecting apparatus comprising a support for the material to be inspected, a housing overlying said support provided with means for viewing the surface of material on said support, said housing having an opening in the lower portion of an end wall adjacent said support for the admission of light along and substantially parallel to said support, means for varying the size of said opening, a light source, means for directing light from said source into the housing through said opening, and means for adjusting the angle at which the directed light strikes the surface of material on said support.

9. In a device for detecting imperfections in

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5 the surface of paper and the like, a support for the paper to be inspected, a housing over said support for substantially enclosing the same, said housing having an opening therein permitting the ready insertion and removal of the paper to be inspected and another opening permitting observation of substantially the entire area of the

paper within the housing from a point above the support, and means for directing a beam of light over the paper in a direction substantially parallel to the surface thereof.

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