

Jan. 25, 1927.

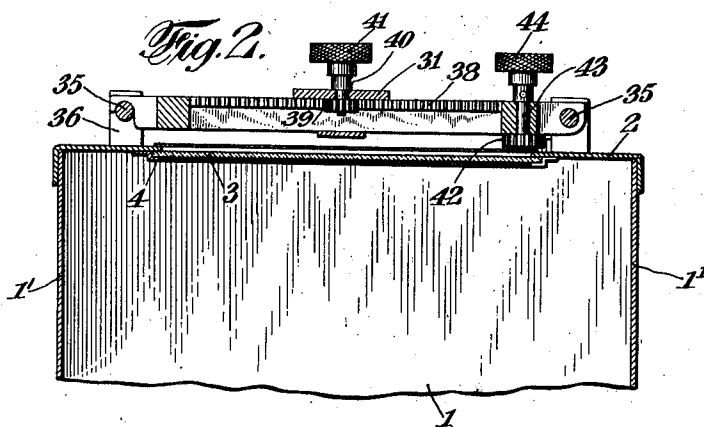
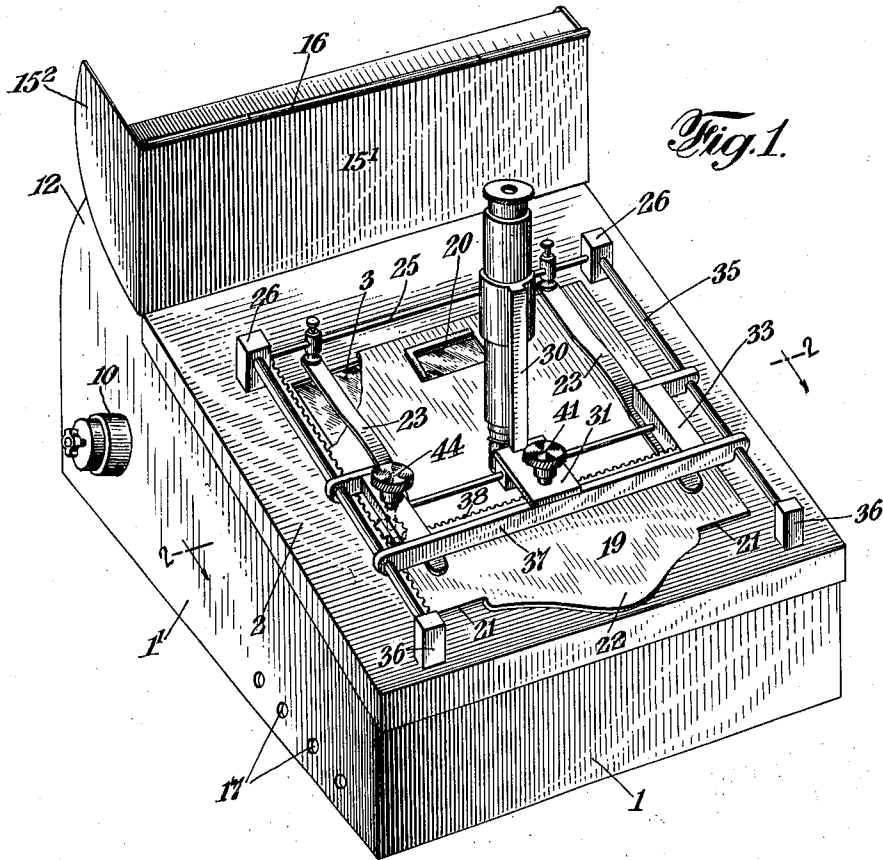
H. CRUGER

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FABRIC INSPECTION APPARATUS

Filed Feb. 21, 1925

3 Sheets-Sheet 1



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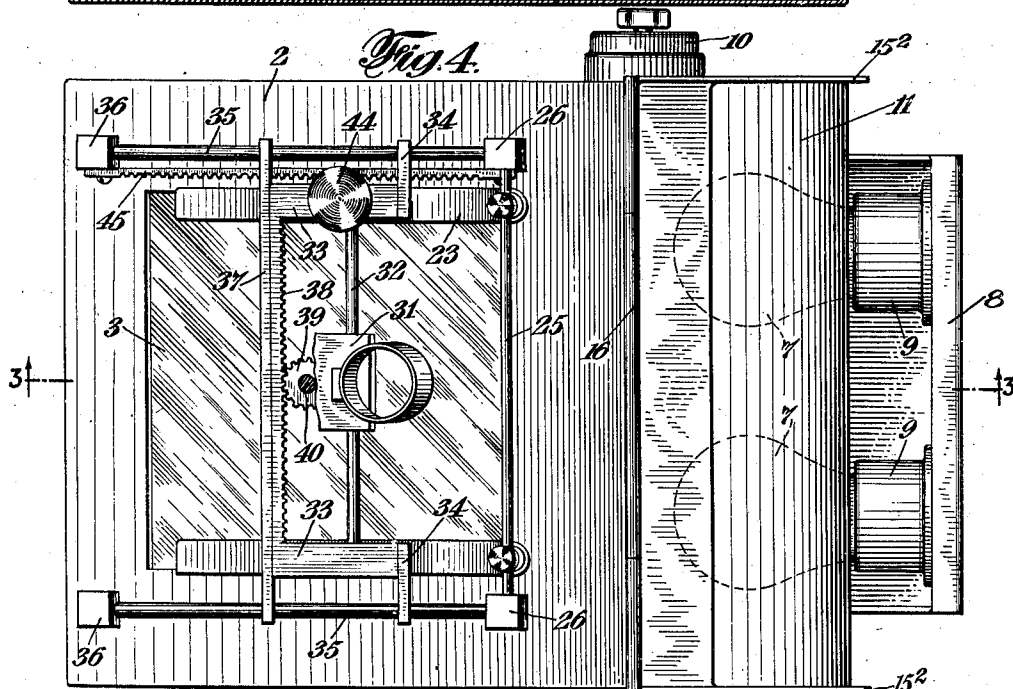
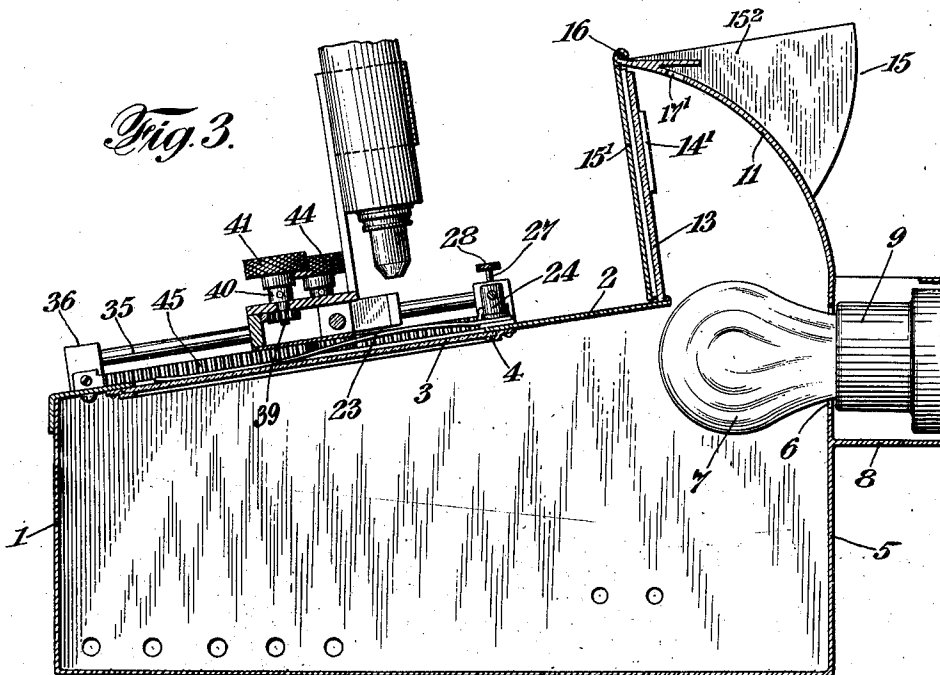
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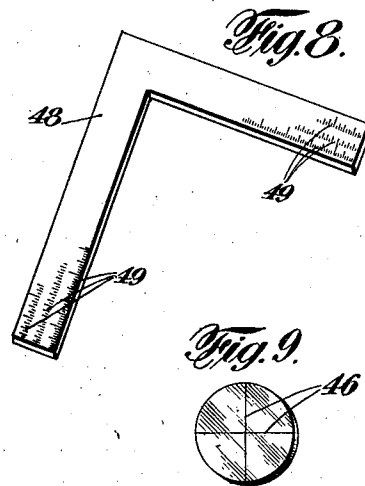
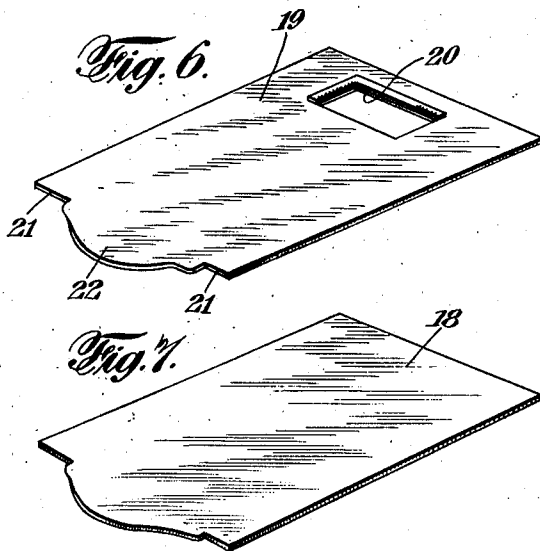
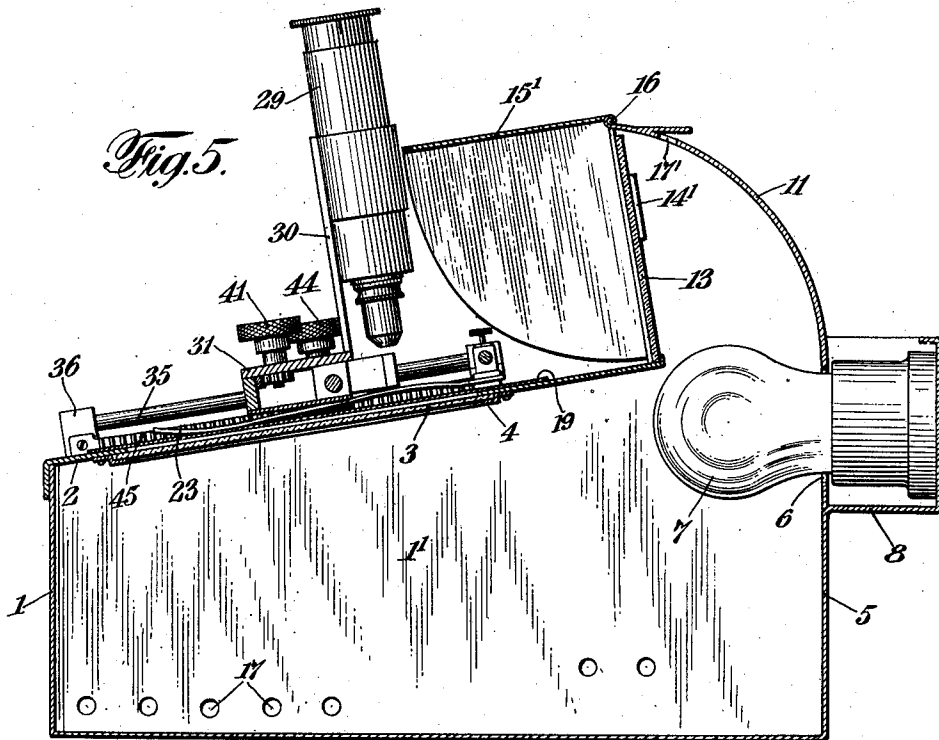
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3 Sheets-Sheet 3



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UNITED STATES PATENT OFFICE.

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FABRIC-INSPECTION APPARATUS.

Application filed February 21, 1925. Serial No. 10,735.

The invention relates to improvements in fabric inspection apparatus, and more particularly to an improved device whereby the threads of a piece of fabric may be counted and inspected through a microscope or magnifying member. In accordance with the invention means are provided whereby a microscope may be moved both laterally and longitudinally above the piece of fabric which is suitably supported, so that the observer can readily count and inspect both the warp and the woof threads of the fabric. In the preferred form of construction means are provided for directing light of uniform character upwardly through the portion of the fabric which is to be inspected, or for directing light of a desired and adjustable intensity downwardly upon the fabric for use with material of such character that the illumination of the same from above is desired.

An object of the invention is the provision of a comparatively simple and inexpensive device of the character referred to, and which shall be dependable and extremely effective in operation. Other objects of the invention consist in the provision of improved elements of construction and combinations of parts, whereby various desirable effects will be obtained, all as will be more fully described in the following specification: and the invention will be further pointed out in the appended claims.

In order that the invention may be more clearly understood attention is hereby directed to the appended drawings, forming part of this application and illustrating one embodiment of the invention.

Referring to the drawings:

Fig. 1 is a perspective view of a fabric inspection device embodying the invention;

Fig. 2 is a transverse vertical section taken on line 2—2 of Fig. 1;

Fig. 3 is a longitudinal vertical section through the device taken on line 3—3 of Fig. 4;

Fig. 4 is a top plan view of the device;

Fig. 5 is a longitudinal section similar to that shown in the Fig. 3, but with a different adjustment of the parts;

Figs. 6, 7 and 8 are perspective views respectively of auxiliary devices; and

Fig. 9 is a detailed plan view of the glass in the microscope carrying cross lines.

Referring to the drawings, the device as shown comprises a light-tight box, 1, the

greater part of which is covered by a top closure member 2. This top closure member has an opening of considerable relative size therein which is closed by a plate of glass, 3, which is preferably ground glass. This pane of glass, 3, may be held in position in any suitable way as by means of the channel, 4, extending about the opening in the top plate, 2, as shown in Fig. 2. The top plate 2 may, if desired, be positioned at a slight inclination to the horizontal with its rear end somewhat higher than its forward end to facilitate inspection of fabric thereon.

The rear wall, 5, of the box, 1, is provided, in the preferred form of construction, with one or several openings, 6, therethrough, through which electric light bulbs, 7, are extended. A flanged extension, 8, of box-like form is secured to the rear surface of the rear wall, 5, of box 1, this serving to hold the sockets, 9, of the electric light bulbs, 7. Two such bulbs are illustrated in the drawings, it being of course understood that one or more bulbs may be used but that it is of course important to secure as uniform illumination of the fabric as possible. The usual electric light wires extend from the sockets, 9, these connections not being illustrated. These connections may extend to a suitable switch, 10, mounted on the side of box, 1, at which the current for the lamp may be turned on or off. It will of course be understood that the electric connection continues from the switch, 10, and may terminate in a suitable plug, which may be inserted in a suitable socket or receptacle for completing the electric circuit of the lamp from any suitable source of current. The electric light bulbs, 7, may be screwed into the sockets, 9, through the openings, 6, in the rear wall, 5, of the box as described.

The rear wall, 5, of the box is preferably extended upwardly and forwardly beyond the lamps, 7, for a considerable distance, on a curve as is indicated at 11. A light-reflecting hood is thereby provided. The side walls, 1'—1' of the box, 1, are extended upwardly at the rear, as is indicated at 12, to cover the ends of the hood, the rear and upper surfaces of which are formed by the curved member 11. The front of the hood thus formed may be covered by a pane of ground glass, or the like, 13, which is preferably removably mounted in suitable vertical guide-ways at the forward edges of the

hood, these guide-ways being provided, for example, by the flanges 14, 14', at the forward edges of the hood. When the ground glass, 13, is in position it will rest upon the rear end portion of the top plate, 2, of the box, 1. The top plate, 2, of the box preferably takes the form of a flanged cover, the flanges of which are adapted to press firmly against the upper portions of the side walls and the front wall of the box, with the rear edge of the cover extending a short distance within the side and front flanges of the hood construction. This cover plate may be wholly or partly removable by sliding the same forwardly if it is desired to obtain access to the lamps, 7, as for the purpose of replacing the same.

A shield member, 15, is preferably hingedly mounted, as is indicated at 16, to the front upper edge of the stationary hood members 11, 12. This shield, 15, comprises a transversely extending portion, 15', and end portions 15² which may each be in the form of a sector of a circle. This shield may be swung into the position shown in Figs. 1 and 3 in which the front portion 15' thereof extends downwardly in front of the ground glass, 13, to entirely prevent the light from the lamps passing out through glass, 13, above plate 2. Or, if it is desired to examine the fabric on plate 2 by light above the same, the shield, 15, may be swung upwardly into the position shown in Fig. 5 in which the portion 15' of the shield extends forwardly from the opening in which ground glass, 13, is positioned, in which case the light from the lamp will be reflected downwardly and forwardly from the curved surface, 11, at the rear of the box and from the inner surface of shield portions 15² and 15', so that this light will be directed downwardly upon the fabric on plate 2. The light thus directed above the fabric may be adjusted in intensity by closing or opening the shutter 15 to a greater or less extent. Thus the shutter may be adjusted so that the forward portion 15' thereof will extend downwardly and forwardly at a sharp angle to leave only a comparatively small opening between the lower edge of the portion 15' of the shutter and the top surface plate 2 of the box. Shield 15 will preferably be held impositively in any adjusted position as by friction of the side wings 15² of the shield against the side surfaces 12 of the fixed hood over which they fit rather closely.

The inside of the box is preferably made light-reflecting as by giving the same a coat of white paint. The upper surface of the bottom and the inner surfaces of the side walls 1', and the front surfaces of the rear wall, 5, and hood 11, and the inner surfaces of shield members 15' and 15² may be made light-reflecting. The inner surfaces of the

rear wall 5, 11 preferably joins side walls 1', 12, by suitable curved surfaces, so that light impinging against the same will be reflected forwardly and inwardly, towards the longitudinal center line of the apparatus, to concentrate the light directed upon or through the fabric.

The frame elements thus far described may be formed of any suitable material such as sheet metal. The side members 1' of box 1 may be provided with small openings, 17, 17', therethrough for ventilation.

When the fabric is to be examined entirely by light from above, the ground glass, 3, in top plate 2, may be entirely covered by a removable plate, 18, Fig. 7, which may be formed of suitably shaped sheet metal and which may be slipped into position upon the top plate 2 to entirely cover ground glass 3 and thereby prevent light from beneath reaching the fabric, which may be positioned upon this plate 18.

When it is desired to examine fabric entirely by light from beneath the same, the shield, 15, may be closed, as is indicated in Figs. 1 and 3, to entirely cover the vertical ground glass 13. The piece of fabric to be examined will now be positioned upon the ground glass, 3, in top plate 2 and suitably held in flat position so that uniform light will shine upwardly through the fabric.

It is usually desirable to examine only a comparatively small portion of fabric and to have the light from underneath pass only through this small section of cloth. Accordingly one or more slides or plates such as that indicated at 19 in Figs. 1 and 6 are provided, plate 19 being shown as formed of suitable opaque material such as sheet metal with a rectangular opening or window, 20, formed through the rear portion of the same. Any number of slides or plates such as that shown at 19 may be provided, each having an aperture similar to that shown at 20 in Fig. 6, these apertures, however, being of different sizes in the different plates, so that sections of fabric of different size may be examined. It is not deemed necessary to illustrate more than one such slide.

When a piece of fabric is to be examined by light passing upwardly through the same, the fabric is placed upon the ground glass, 3, and a suitable slide, such as 19, positioned above the same, care being taken to have the fabric lying flat and unwrinkled. Slide 19 is rectangular and the aperture, 20, therethrough is also rectangular with its edges parallel to the edges of the slide. It is therefore a simple matter to adjust the fabric and the slide so that the edges of aperture 20 will be approximately parallel to the longitudinal and transverse threads of the fabric. This adjustment may be facilitated, for example, by sliding one of the side edges of the slide against one of the side edges

of the opening in which glass 3 is positioned, or by pressing the rear edge of the slide against the rear edge of this opening, or by aligning the front edges, 21, of the slide against the forward edge of the opening in which glass 3 is positioned. The slide may be readily moved by means of the forwardly extending projection, 22, which may be held between the thumb and finger of the operator.

When the slide and fabric are thus properly positioned the fabric may be subjected to pressure to insure the same lying flat against glass, 3. This may be accomplished, for example, by means of the forwardly directed spring fingers 23, 23. Each spring finger, 23, is preferably carried by an upwardly extending member, 24, which is slidably mounted on a transversely extending rail or rod, 25, the ends of which are supported in blocks 26, 26, mounted upon top plate 2. Fingers 23 may thus be slid along rod, 25, into desired positions where they will bear upon slide, 19, and exert pressure upon the fabric beneath the same, whereupon the spring fingers are secured in position and put under pressure by means, for example, of screws, 27, which screw into suitable threaded openings in blocks, 24, and are adapted to bear against rod, 25. These screws are preferably provided with knurled heads, 28, by which they may readily be turned.

A microscope or suitable magnifying member indicated at 29 is carried by a vertical arm, 30, extending upwardly from a carriage, 31, which is slidably mounted on a transverse rod, 32. Rod 32 is carried by short longitudinally extending members 33, 33, the rear ends of which carry laterally extending arms 34, 34, which are slidably mounted on longitudinally extending side rods 35, 35. These rods are secured at their rear ends to the blocks, 26, previously mentioned and at their forward ends to similar blocks, 36, 36, mounted upon top plate 2. The forward ends of the longitudinally extending arms 33 are secured to a transverse bar, 37, the ends of which are slidably mounted on rods, 35, the frame comprising transverse members, 32, 34 and 37 together with the longitudinal members, 33, thus being slidably mounted on rods, 35, for longitudinal movement over plate 2.

The rear surface of transverse bar, 37, is provided with a rack, 38, with which coacts a pinion, 39, on a short vertical stud, 40, which is rotatably mounted in carriage, 31. This vertical stud carries a knurled head, 41, at its upper end by which it can be turned so that carriage, 31, and the microscope carried thereby may be moved step by step in transverse direction, across top plate 2 of the box.

The frame or carriage comprising mem-

bers 37, 32, 33 etc., by which the transversely movable carriage, 31, is carried, is adapted to be moved longitudinally step by step by means of the coaction of a suitable rack and pinion, or other suitable devices for moving the same step by step. As shown in the drawings a pinion, 42, may be carried by a short vertical stud, 43, which is rotatably mounted in one of the frame members, 33, of the longitudinally movable frame, this stud carrying a knurled head, 44, at its upper end by which it can be turned. Pinion 42 coacts with a stationary rack, 45, which is secured to top plate 2 and may extend from front to rear alongside one of the blocks, 26, and the corresponding front block, 36.

By the means described, the microscope may be readily positioned over window, 20, in plate 19, beneath which the fabric to be examined is held in flat position. The microscope is preferably provided with accurately positioned cross lines, 46, which may be formed upon a suitable glass mounted in the microscope as is indicated in Fig. 9. These lines are accurately positioned at right angles to each other and may be aligned with warp or woof threads of the fabric to act as an indicator or pointer to facilitate counting the threads. The window, 20, of plate 19, is preferably provided with suitable scales alongside one longitudinal and one lateral edge thereof, as is indicated at 47, in Fig. 6, these scales preferably being three in number to indicate lengths in fractions of an inch, in centimeters, and in the French measure of lignes. It is accordingly a simple matter to move the microscope step by step over the fabric which is illuminated through window, 20, and to thereby count both the longitudinal and the lateral threads.

It may be noted that, for ease in adjusting the fabric in position on the apparatus, the whole carriage bearing the microscope, comprising frame members 37, 33, 34 and 32 may be swung upwardly about rod 35 at the left, (Fig. 1), as axis, this being permitted by the fact that parts 37 and 34 are merely notched for sliding engagement with rod 35 at the right, Fig. 1.

If a different kind of material is used, which should preferably be illuminated from above instead of by light passing through the fabric, the slide, 18, having no aperture therein is placed above the ground glass, 3, and the fabric laid thereon. In this case the fabric may be held flat by passing an angular removable member thereon such as the L-shaped member, 48, illustrated in Fig. 8 which member should have sufficient weight to hold the fabric reasonably flat. The edges of this member may be provided with scales, such as scales of the three units of measurement referred

to above, such scales being indicated at 49.

It will be noted that the provision of means for adjusting the position of the microscope laterally and longitudinally is much more effective for the desired purpose than would be the provision of means for moving the fabric in a similar manner beneath a microscope having a fixed position. This is for the reason, among others, that the fabric must remain substantially flat in order to obtain a uniform magnification thereof and it would be extremely difficult to move the fabric step by step beneath the microscope without causing the same to buckle more or less. Furthermore, the movement of the microscope while holding the fabric stationary permits the use of the stationary screen such as slide member, 19, above the fabric this screen permitting the uniform illumination of a desired small portion of the fabric only, through the opening of desired size, such as window 20 in screen 19. If the fabric were to be moved to obtain the relative adjustment between the microscope and the fabric, it would probably be necessary to move this slide or screen, 19, therewith, and in this case, it would not be possible to obtain uniform, comparatively intense illumination through the fabric, as is done in the present case where illumination comes entirely through the opening, 20, which remains fixed in position during the inspection.

It will also be noted that the invention provides means for illuminating the fabric from above, if desired, and varying the intensity of such illumination as desired by adjusting the angular position of the shield or shutter, 15. Also, that constant illumination from below is provided when desired, which illumination may be varied in intensity by use of screens or plates such as 19, having openings of different size through which the light will pass, and that the invention also permits the total elimination of the light from underneath by the use of a solid or entirely opaque plate such as 18; and that also, the entire fabric may be illuminated from beneath, if desired, by holding the fabric upon the ground glass, 3, without the use of any plate or screen above it.

It should be understood that the invention is not limited strictly to the exact details of construction which have been particularly described, but that the invention includes all suitable equivalents thereof, the scope of the invention being indicated by the appended claims.

I claim:

1. In fabric inspection apparatus, the combination of a box having a transparent fabric-supporting plate, a source of light within said box, said box having an upward extension with an opening through which light from said source may pass down upon

said surface, and said box and upward extension having light reflecting inner surfaces adapted to cause the illumination of the upper and lower surfaces of said plate, an adjustable shutter for said opening in said upward extension, and means enabling the illumination from beneath said plate of selected areas only of fabric upon said plate.

2. In fabric inspection apparatus, the combination of a box having a transparent fabric-support of substantial extent through the whole of which light may pass, a source of light within said box, means for reflecting light from said source uniformly upon said support from below to uniformly illuminate a considerable extent of a fabric positioned on said support, slidable opaque means for holding a fabric upon said support, having a plurality of inspection openings therein enabling the light to shine through only selected areas of said fabric, a magnifying member, means for movably supporting the same above said opaque means, means for adjusting the lens of said member vertically for focusing to different sizes of inspection openings, and means for adjusting the position of said magnifying member both longitudinally and laterally of a selected inspection opening.

3. In fabric inspection apparatus, the combination of a light-tight box having an upper surface with an opening therein, a light-source, means for directing the light therefrom through said opening, a magnifying member, a carriage for the same above said upper surface, means for slidably supporting said carriage, arranged to permit the pivotal swinging of said carriage to one side of said opening, at any point in its travel, to permit adjustment of the fabric, and manually controlled step by step means for moving said carriage in one direction, and for moving said magnifying member, relative to said carriage, in a different direction, to adjust the position of said magnifying member step by step above fabric extended over said opening, said manually controlled means holding said carriage and magnifying member in adjusted positions.

4. In fabric inspection apparatus, the combination of a fabric support, a single stationary source of light, an enclosure therefor, and means comprising reflecting means for directing the light therefrom uniformly either through the fabric, from below, or upon the fabric from above, at will.

5. In fabric inspection apparatus, the combination of a box having a transparent top plate, a source of light within said box, means for reflecting light from said source uniformly upon said plate from below, to illuminate a considerable extent of a fabric positioned on said plate, means for holding fabric upon said plate, comprising a series of opaque plates having differently sized

openings therethrough, any one of which, as desired, may be positioned on the fabric, a magnifying member, and means for movably mounting the same above said transparent and opaque plates.

6. In fabric inspection apparatus, the combination of a box having a transparent fabric-supporting plate, a source of light within said box, said box having an upward extension with an opening through which light from said source may pass down upon said surface, and said box and upward extension having light reflecting inner surfaces adapted to cause the illumination of the upper and lower surfaces of said plate, means for holding fabric upon said plate, comprising an opaque plate with an inspection opening therein, to be positioned upon said fabric when the latter is to be examined by light from below, and an opaque plate to be positioned upon said transparent plate, and means for holding the fabric upon said last named opaque plate, when the fabric is to be examined by light from above.

7. In fabric inspection apparatus, the combination of a fabric support, means for holding a piece of fabric flat and immovable thereon, permitting the inspection of a desired limited area thereof, an artificial source of light and means for uniformly illuminating therefrom an extent of said fabric many

times greater than and including said limited area, a magnifying member, and means for adjusting the position thereof, step by step, in two directions over the fabric.

8. In fabric inspection apparatus, the combination of a box having a transparent top plate, a source of light within said box, means for reflecting light from said source uniformly upon said plate from below, and also from above, to illuminate a considerable extent of a fabric positioned on said plate, means for varying or shutting off the downwardly-reflected light, and means for holding fabric on said plate.

9. In fabric inspection apparatus, the combination of a transparent fabric support, a removable plate, having an inspection opening therein, for holding a piece of fabric flat and immovable thereon, a light source, means for reflecting light therefrom either upon the bottom or the top side of the fabric, as desired, a magnifying member having a glass with cross lines thereon, mounted above said plate, and means for adjusting the position thereof, step by step, in two directions, to enable said cross lines to be aligned successively with threads of the fabric, in counting the same.

In testimony whereof I have signed my name to this specification.

HAROLD CRUGER.