United States Patent [19]

Carter et al.

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[45] **July 31, 1973**

[54] **SHADOW-LINE PROJECTOR FOR ASSEMBLY REFERENCE**

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[73] Assignee: **Carter Products Company, Inc.**, Grand Rapids, Mich.

[22] Filed: **Dec. 10, 1970**

[21] Appl. No.: **96,871**

[52] **U.S. Cl.** ..... **353/62**, 143/168 B, 240/2 D

[51] **Int. Cl.** **G03b 21/00**

[58] **Field of Search** ..... 240/2 D; 143/168 B; 353/42, 24, 122; 352/227, 122, 62

[56] **References Cited**

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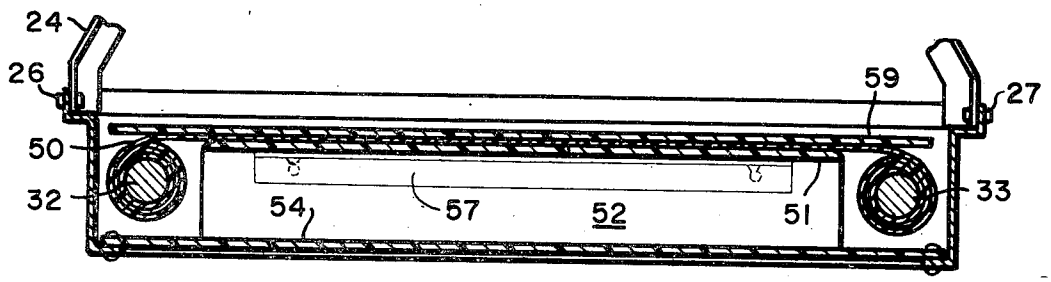
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[57] **ABSTRACT**

A shadow-line projector adapted to establish reference lines on a work surface, the lines being shadows cast by stripes located on a transparent sheet preferably carried by rollers capable of shifting the sheet to project a plurality of sets of reference lines in sequence.

3 Claims, 17 Drawing Figures



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SHEET 1 OF 6

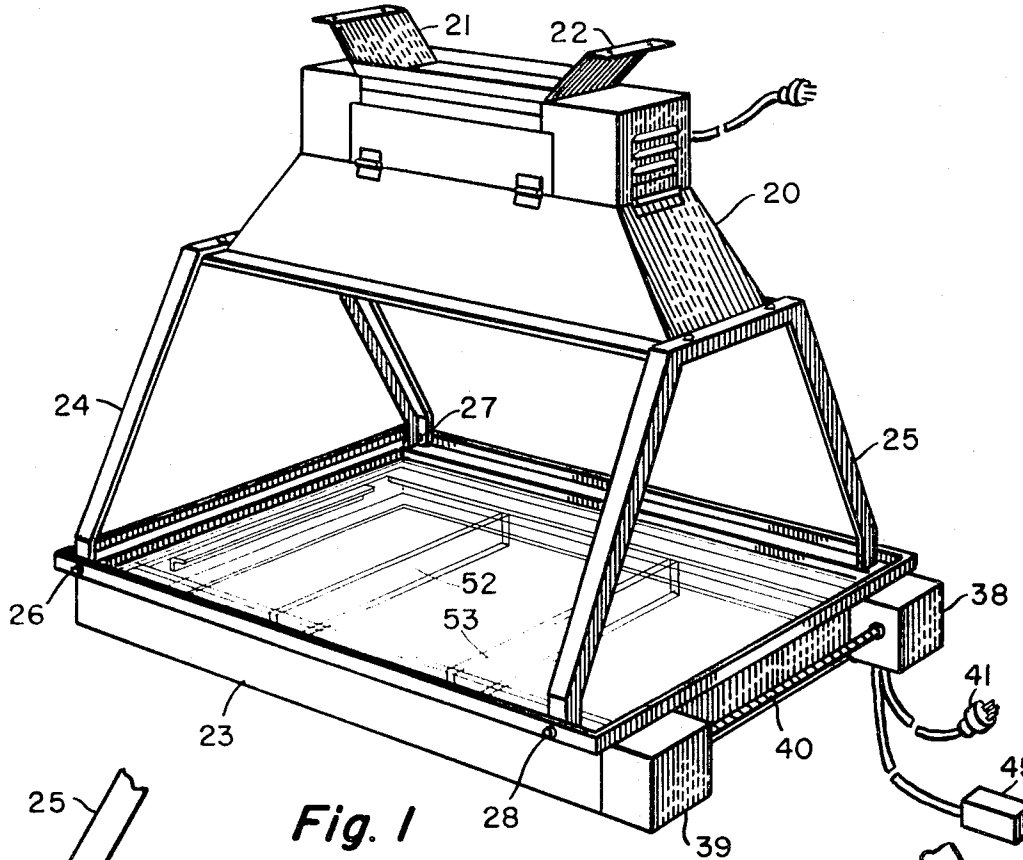


Fig. 1

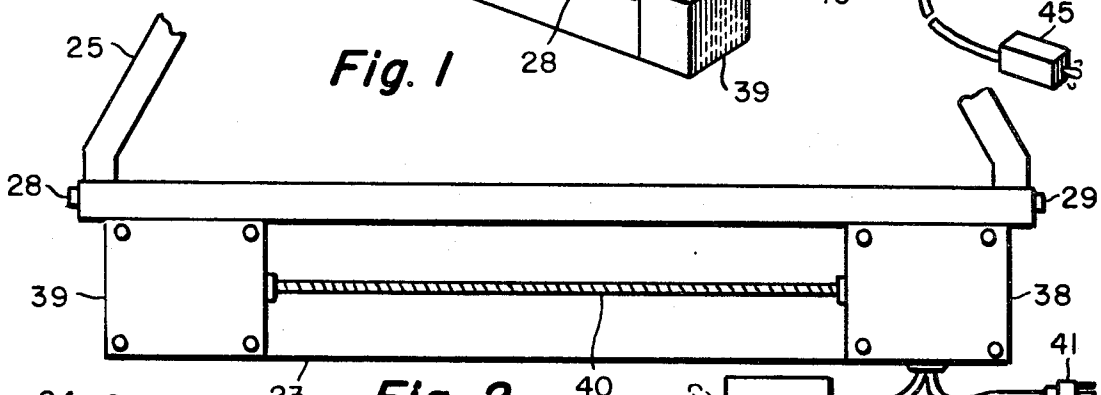


Fig. 2

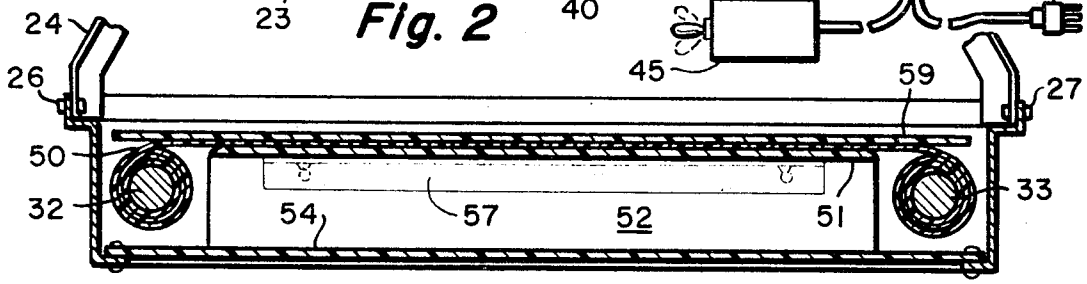


Fig. 3

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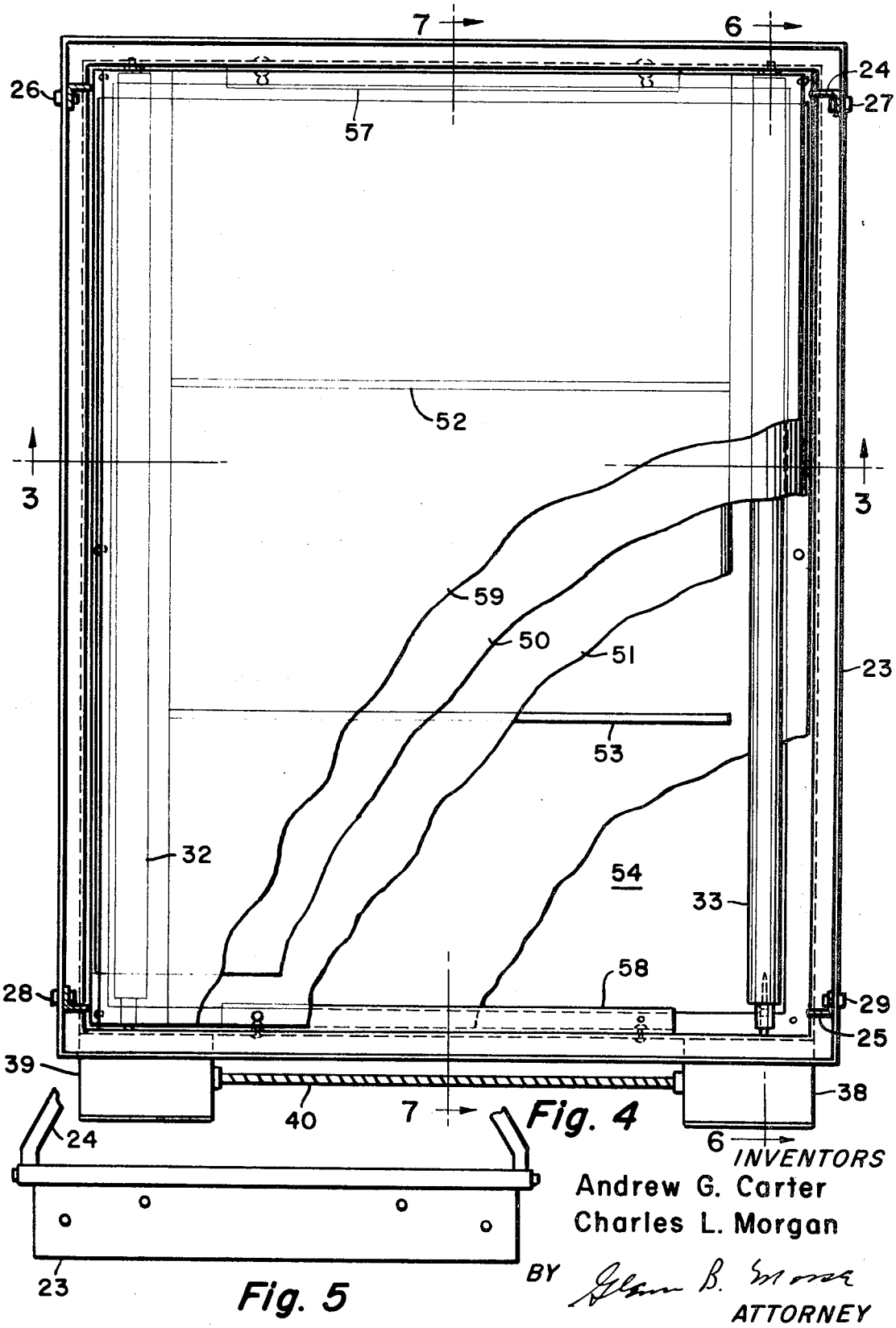


Fig. 4

Fig. 5

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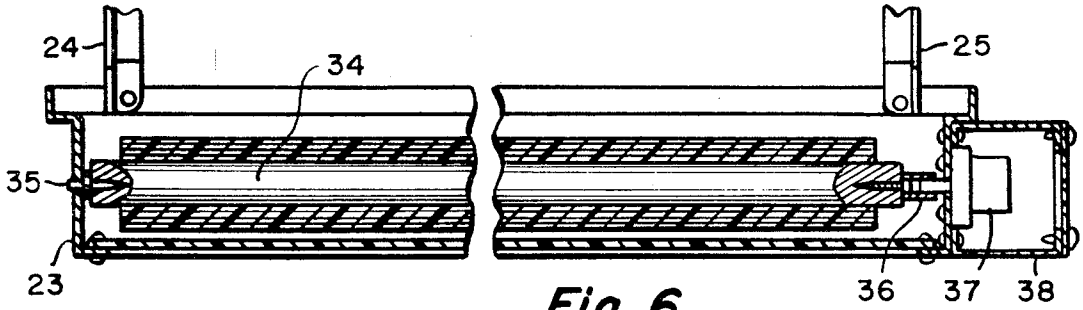


Fig. 6

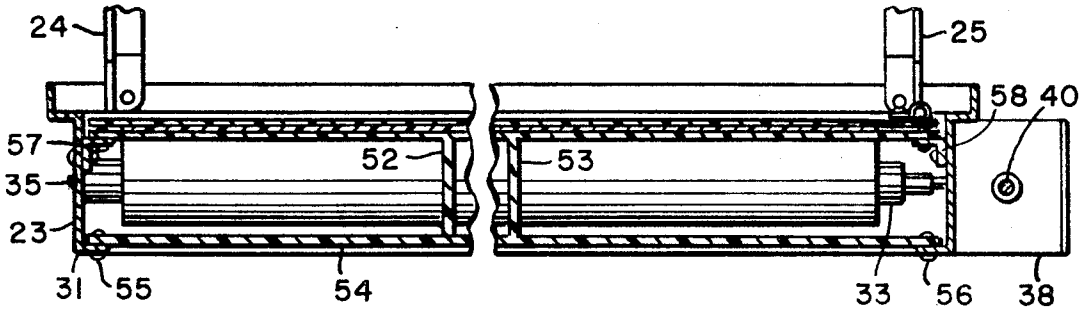


Fig. 7

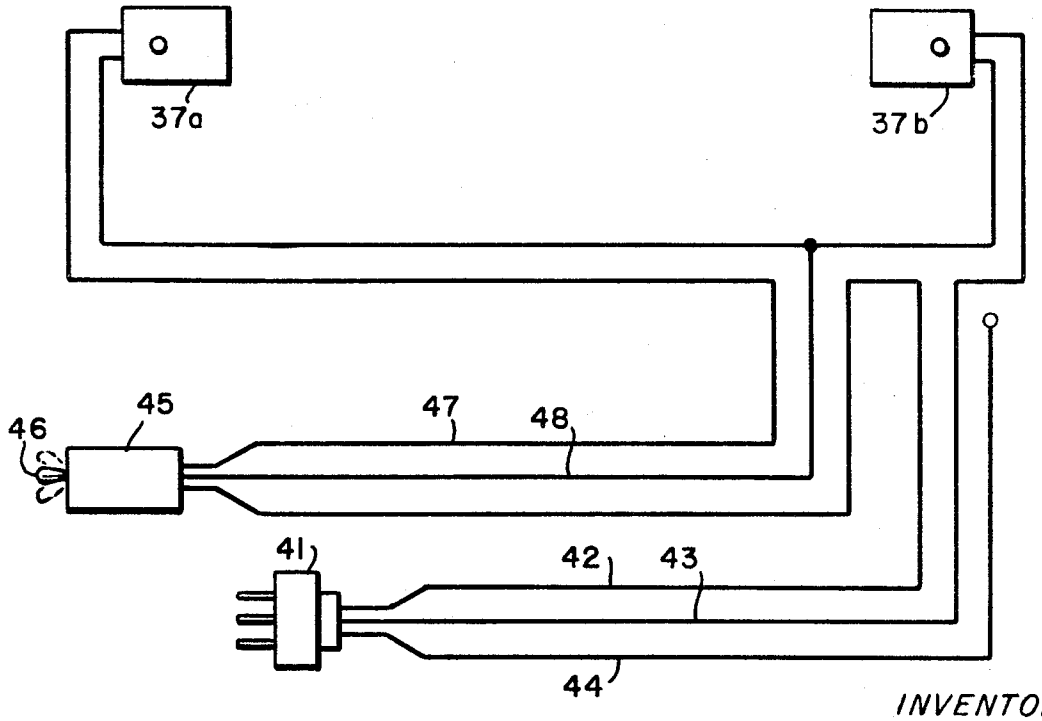


Fig. 8

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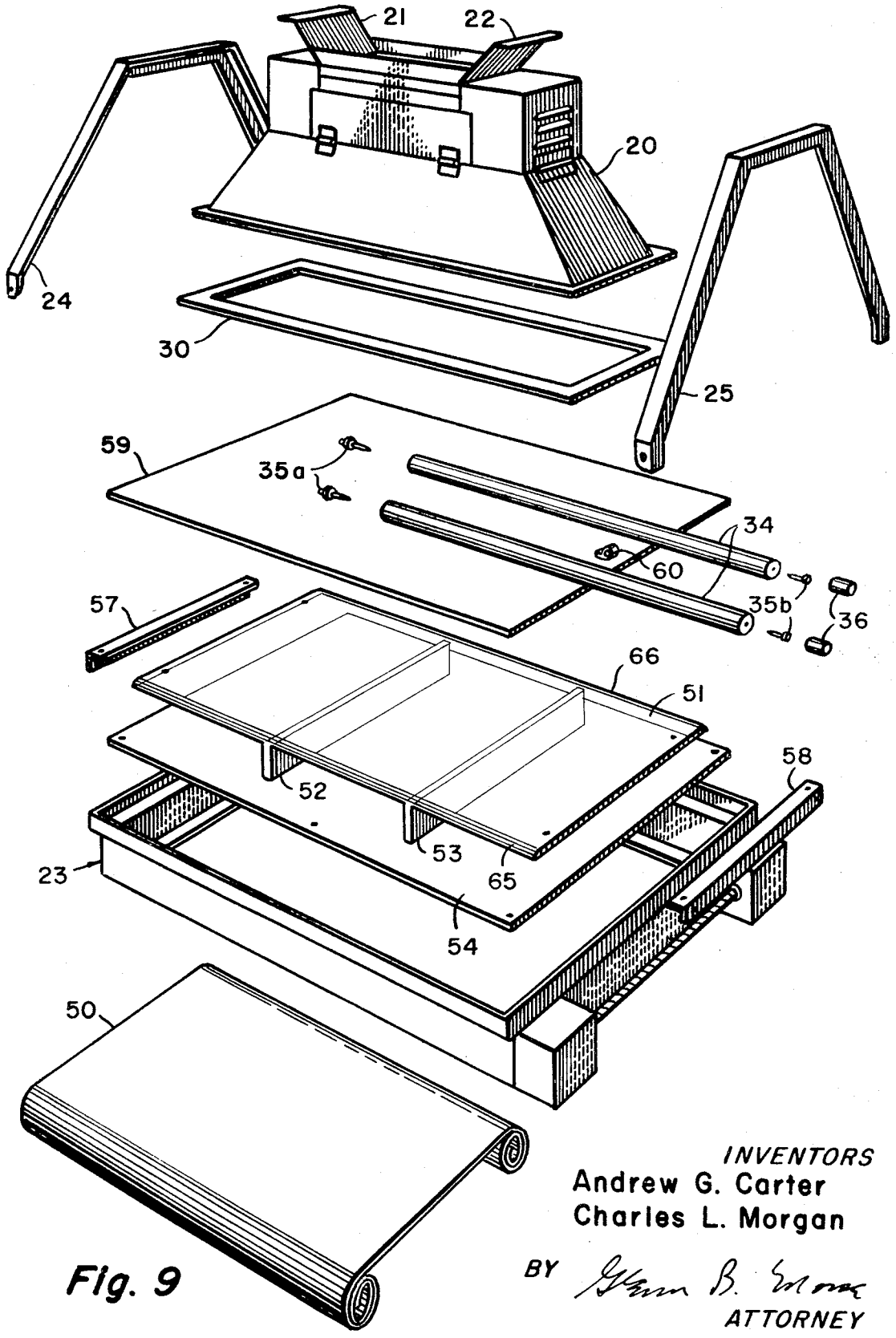


Fig. 9

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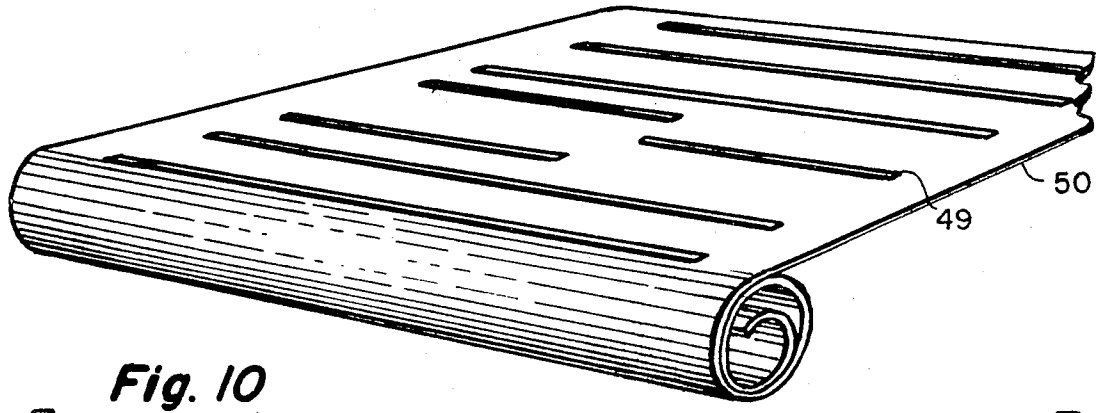


Fig. 10

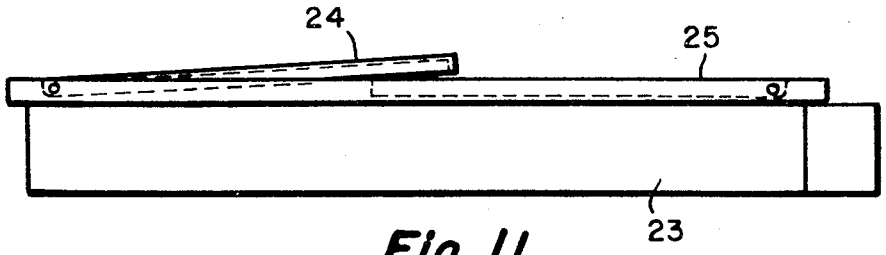


Fig. 11



Fig. 12



Fig. 13

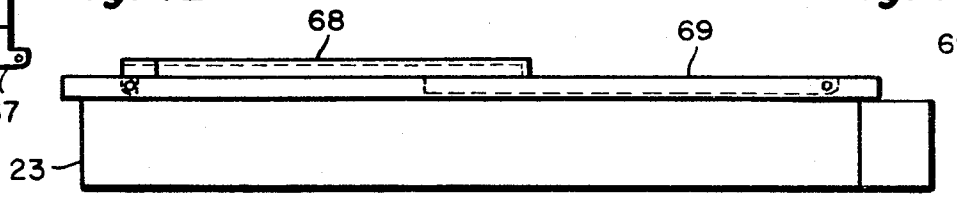


Fig. 14

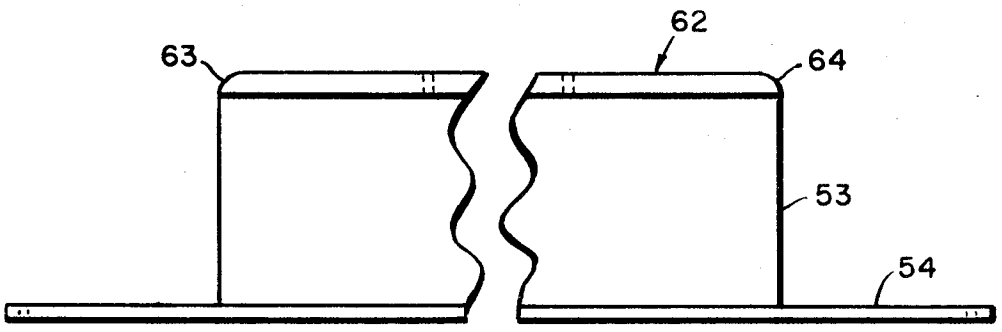


Fig. 15

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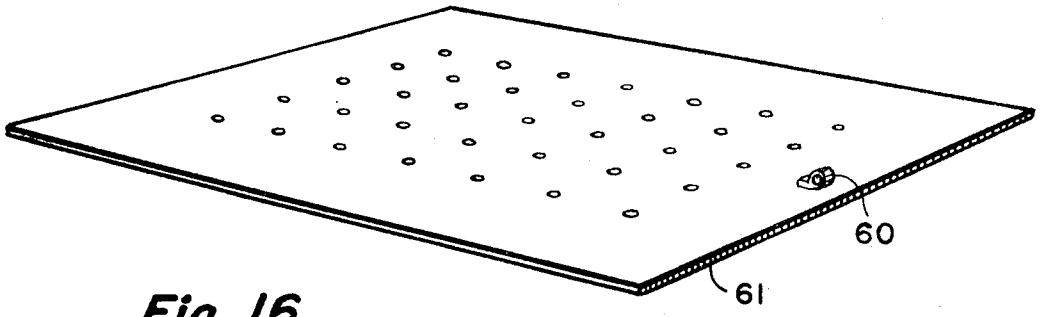


Fig. 16

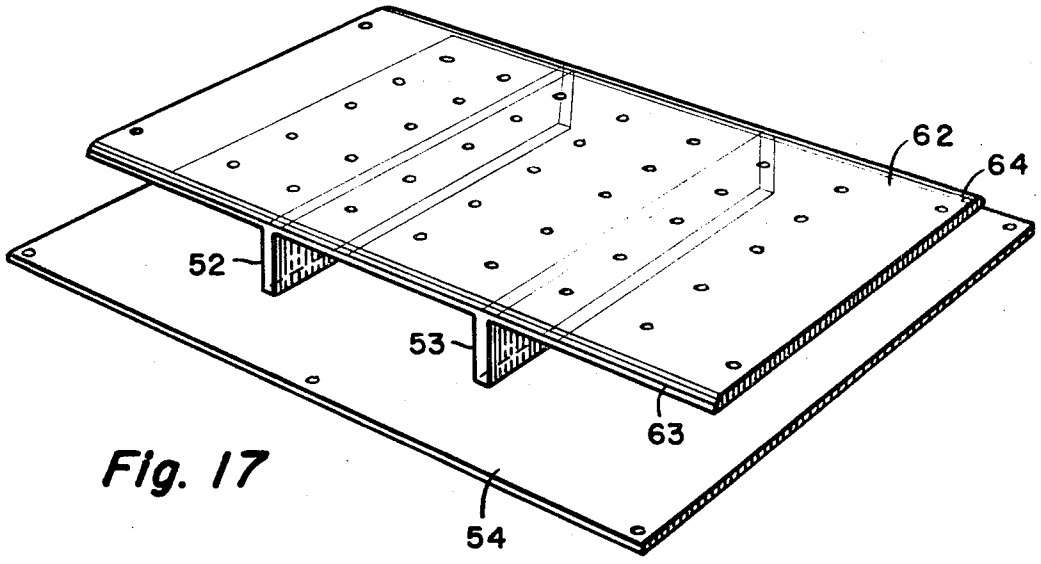


Fig. 17

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SHADOW-LINE PROJECTOR FOR ASSEMBLY REFERENCE

BACKGROUND OF THE INVENTION

Shadow-line projectors have been used to establish reference lines on work surfaces in a number of situations. The applications of the shadow-line principle in general use are used to indicate the path of a cutting or machining operation on stock being fed into a machine. A typical example of such an application is shown and described in our application Ser. No. 79,207, filed on Oct. 8, 1970. The device illustrated in this application indicates the path of cut that a saw will follow on a rough plank being moved into the saw on a feed table.

The present inventors have recognized that it would be desirable to utilize the principles of shadow-line projectors in establishing reference lines to assist workmen in assembling a number of components in particular dimensional relationships with each other. In the manufacture of prefabricated housing, for example, it is necessary to put together a considerable number of panel sections, each of which includes an assortment of parallel studs and interconnecting members, and additionally requires the placement of a number of items in particular positions in the wall structure. Known forms of shadow-line devices are not practical for this sort of assembly operation, primarily because of the difficulty in re-aligning the interference lines that produce the shadows. A given floor area is not usually devoted exclusively to the assembly of one particular wall section. Since a housing unit will contain a number of these wall sections which are not identical in construction, it would be necessary to re-align the shadow-line device each time the unit assembled was changed. This would be a time-consuming operation, and would require considerable care of the part of the workmen responsible for the readjustment. The general objective of the present invention has been to utilize the principles of shadow-line projection in a device capable of projecting a large number of reference lines, in which the shifting from one pattern of lines to another is predetermined in the sense that an entire pattern is shifted at once.

SUMMARY OF THE INVENTION

A projector embodying the present invention provides a series of stripes on a transparent sheet, the strips being opaque and of a desired width to project a particular width of shadow on a work surface. A section of this transparent sheet corresponds to a particular assembly project, and all of the parallel reference lines required for this project are incorporated on that section of the sheet. Preferably, the sheet is carried by r'llers engaging the opposite ends of the sheet in the manner of a scroll. The section of the sheet being exposed to the projection is supported by a transparent panel, which preferably includes transparent stiffening beams to maintain the sheet in a co-planar relationship. A pressure plate on top of the sheet, sandwiching the sheet between the support panel and the pressure plate, assists in maintaining the flatness of the sheet so that the projection is a distortion-free as possible. It is obvious that any wave-like deformity of the sheet carrying the interference stripes will induce similar deformity in the shadow-line. It is also referable that the materials, selected for the sheet, the support panel, and the pressure plate be selected so that electrostatic attraction can be used to assist in maintaining the flatness of the

sheet, both through direct adhesion, and by establishing sufficient drag to the movement of the sheet to tend to eleminate any accumulation of wrinkles. The preferred form of the invention also includes perforations in both the supporting panel and the pressure plate to eliminate the formation of bubbles of air that will tend to interfere with flatness. The entire unit providing the support for the sheet is mounted in a frame preferably suspended from a conventional linear light source in which light is generated by an incandescent straight-line filament. The stripes on the transparent sheet are arranged parallel to this filament. Transverse reference lines are either established by rotating the projector 90 ° about a vertical axis (accompanied by a suitable shifting of the section of the transparent sheet to present the new set of reference lines), or by the use of a second projector adapted to project lines on the same working surface. The shifting of the section of the transparent sheet is accomplished preferably by a motor drive capable of shifting the scroll in either direction.

DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of a complete shadow-line projector embodying the present invention.

FIG. 2 is an end elevation of the lower portion of the device shown in FIG. 1, and containing the structure for the placement and support of the sheet carrying the interference stripes. FIG. 2 is on an enlarged scale over FIG. 1.

FIG. 3 is a section on the plane 3—of FIG. 4.

FIG. 4 is a plan view of the portion of the machine shown in FIG. 2.

FIG. 5 is a view of the opposite end of the structure from that shown in FIG. 2, on a reduced scale.

FIG. 6 is a section on the plane 6—6 of FIG. 4.

FIG. 7 is a section on the plane 7—7 of FIG. 4.

FIG. 8 is a schematic wiring diagram showing the circuit for controlling the motors used to position the rollers.

FIG. 9 is an exploded view showing the components of the assembly illustrated in FIG. 1.

FIG. 10 is a perspective view showing the placement of the interference strips on the transparent sheet.

FIG. 11 illustrates a folded form of the structure shown in FIG. 2.

FIG. 12 illustrates a modified form of suspension link for interconnecting the unit shown in FIG. 2 with the light source.

FIG. 13 illustrates the opposite link used in association with the FIG. 12 link.

FIG. 14 illustrates the folded position of a device incorporating the FIG. 12 and FIG. 13 suspension links.

FIG. 15 is an enlarged view of the support unit for the transparent sheet.

FIG. 16 is a perspective view of a perforated pressure plate used on top of the transparent sheet.

FIG. 17 illustrates a modified support assembly for the transparent sheet, utilizing perforated surfaces.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The components of the projector shown in FIG. 1 are best shown in FIG. 9. The conventional linear light source 20 contains a normally incandescent straight line filament running generally in a direction parallel to the longest dimension of the device. Light is projected downwardly through the open bottom of this device,

and through the transparent components of the shadow-line unit. A frame generally indicated at **23** is suspended from the light source **20** by the links **24** and **25** pivotally connected to the frame **23** as indicated at **26–27** and **28–29.** A rectangular piece **30** is normally provided to reinforce the lower flange of the projector housing, and provide a firm shelf extending from the ends of the housing for supporting the bail-shapped link members **24** and **25.**

The frame **23** is essentially a box-like structure of sheet metal having an open bottom defined by the marginal flange **31.** Rollers **32** and **33** are rotatably mounted on opposite sides of the frame structure **23,** as best shown in FIGS. **3, 4, 6** and **7** These rollers are of a type of structure commonly associated with roller curtains, and include a central cylindrical member **34** having a shoulder pin **35** functioning as a bearing at one end, and having a coupling **36** at the opposite end for interconnecting the roller with its drive motor **37.** This construction is typical of two roller assemblies, the drive motors being protected by the housings **38** and **39.** A flexible conduit **40** extends between these housings for carrying the wiring associated with the schematic housings for carrying the wiring associated with the schematic circuit diagram shown in FIG. **8.** Energy is supplied to the circuit via the plug-in connector **41,** and applied to the motors **37***a* and **37***b* through the leads **42** and **43.** The ground connection **44** is preferable. The direction of rotation of the motors **37***a* and **37***b* is controlled by the toggle switch **45,** through manipulating the lever **46** between the positions indicated in dotted lines in FIG. **8.** This circuit is a conventional arrangement, and the effect of it is to apply the voltage selectively to either the motor **37***a* or the motor **37***b.* As either one of these motors is activated, the roll associated with the opposite motor drags as an idler. Each of the motors is of a conventional type of construction incorporating a clutch device which connects the motor to the output shaft only when power is applied.

The reference shadow-lines are generated by intercepting the light from the light source **20** with the interference lines established by the stripes **49,** shown in FIG. **10,** applied to the sheet **50** wound upon the rollers **32** and **33.** It is usually most convenient to apply the stripes **49** in the form of narrow pressure-sensitive tape which can be semi-permanently attached to the sheet **50.** This sheet is, of course, transparent, and is preferably of a clear acetate.

The structure for supporting the transparent sYeet **50** includes the transparent supporting panel **51** stiffened by the transparent beams **52** and **53.** These beams are preferably adhesively secured to the underside of the panel **51,** and rest on the transparent lower panel **54.** It is preferable that the beams **52** and **53** also be adhesively secured to the lower panel. The adhesive used on the upper and lower edges of the beams **52** and **53** must also be transparent to avoid casting a transverse shadow. The lower panel **54** rests on th flange **31** of the frame **23,** and is secured to the flange by fastenings indicated at **55** and **56** in FIG. **7.** The subassembly including the panel **51,** the beams **52** and **53,** and the lower panel **54,** is additionally supported by the shelves formed by the angles **57** and **58** secured to the sides of the box frame **23** in any convenient manner. These shelves engage the underside of the panel **51.** This structure forms a transparent table over which the sheet **50** is selectively placed by the motors **37***a* and **37***b.* The formation of at least the panel **51** of plexiglass has been found to provide the necessary transparency and also developed the electrostatic attraction between the panel surface and the sheet **50** to assist in maintaining the flatness of the sheet to avoid distortion of the shadow-lines. This arrangement has been found very effective in the construction of a machine in which the panel **51** was on the order of 4 feet long by 2 feet wide. Adequate transparency resulted from the use of plexiglass of a quarter inch thickness for the panel **51** and the beams **52** and **53,** and one-eighth of an inch in thickness for the lower panel **54.** A further and preferred) expedient for assuring the flatness of the sheet **50** is the transparent pressure plate **59.** This plate may either rest freely on the top of the Sheet **50,** being confined against lateral movement by the sidewalls of the box frame **23,** or may be hinged to the box structure as shown at **60.** This plate is also preferably of one-eighth of an inch thick plexiglass. In the modification of the invention shown in FIGS. **16** and **17,** the pressure plate **61** and the support panel **62** are preforated to permit the escape of air, and thus inhibit the development of an air cushion between the sheet **50** and the support structure. The sub-assembly shown in FIG. **17** includes the same lower plate **54** and beams **52** and **53** as in the non-Perforated sub-assembly shown in FIG. **9.** In both cases, the opposite edges of the support panel are rounded as shown at **63–64** in FIG. **17** and **65–66** in FIG. **9,** to provide a gentle curvature at the points where the sheet **50** passes over these edges toward Jhe respective rollers.

When the device is packed for shipment, or is stored during periods of non-use, the suspension links **24** and **25** are disconnected from the light source **20,** and fold downwardly against the box frame **23** as shown in FIG. **11.** This folding action can be improved at a relatively small increase in cost by the formation of one of the suspension links with an off-set as shown at **67** in FIG. **12.** This off-set permits the suspension link **68** to fold down in to parallism with the opposite link **69,** which is formed without an off-set, but is capable of folding below a plane defined by the top edge of the box structure **23.**

We claim:

1. In a shadow line projector, having a linear light source, a frame connected to said light source, and shadow generating means mounted on said frame to intercept light from said source and generate a shadow, an improved shadow-generating means comprising;

a transparent sheet having successive groups of interrelated opaque stripes disposed parallel to said linear light source;

a pair of rollers parallel to said linear light source mounted, respectively, on opposite sides of the frame and connected, respectively, to opposite ends of said sheet;

a transparent panel carried by said frame in supporting contact with the portion of said sheet extending between said rollers;

at least one transparent stiffener beam affixed to said panel on the face thereof opposite that which supports eaid sheet; and

a transparent flattening plate carried by said frame and on the opposite side of said portion of said sheet from said panel.

2. A Projector as defined in claim **1,** wherein at least one of said panel andplate are perforated.

3. A projector as defined in claim **1,** wherein said sheet is of a material selected to normally exhibit electrostatic attraction to at least one of said panel and said plate.

* * * * *