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DRAWINGS ATTACHED

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(54) APPARATUS FOR INSPECTING FLATTENED FLEXIBLE TUBULAR MATERIALS

(71) I, LENNART NYMAN, of Billdalsgatan 24, 502 64 Boras, Sweden, a subject of Sweden, do hereby declare the invention for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to apparatus for the inspection of continuous lengths of flexible material in flattened tubular form. As we shall explain subsequently, apparatus constructed in accordance with the present invention is particularly useful for the inspection of tubular lengths of textile goods for defects. Such goods may be readily formed into a roll in a completely flat condition. It is not necessary that the tube of material concerned be completely flat during inspection thereof by apparatus constructed in accordance with this invention; and consequently the word "flattened", as used throughout this specification and in the claims, is to be understood not to be limited to "completely flattened" but also to include an incompletely flat condition. It is only necessary that it should be possible to define two sides to the "flattened" material so that by viewing such sides, it is possible to see the entire exterior surface of the tube.

In accordance with the present invention there is provided apparatus for the inspection of continuous lengths of flexible material in flattened tubular form, the apparatus comprising an inspection station and means defining a path of travel for said material longitudinally therethrough, the inspection station including means for illuminating both sides of the material and light reflecting means so located that both illuminated sides of the material are equally and simultaneously visible to a viewer at a single viewing position.

Preferably, an internal spacer or spreader means is provided internally of the flattened tubular material during such inspection.

[Price 25p]

The invention is hereinafter more particularly described by way of example only with reference to the accompanying drawings, in which:—

FIGURE 1 shows a perspective view of a preferred embodiment of apparatus constructed in accordance with the present invention;

FIGURE 2 is a schematic diagram showing how the light reflecting means is arranged in the embodiment of Figure 1 such that both sides of the flattened material may be seen simultaneously from a single position; and

FIGURE 3 shows diagrammatically the path of travel of the flattened tubular material through the apparatus.

The apparatus shown in the drawings has a housing 1 with a frontal viewing aperture 2. At its upper end, the housing is provided with a cradle 3 which is shown supporting a roll 4 of tubular textile material. Such material is formed as a tube which is subsequently flattened out and then rolled up on to a spool. The material is shown in Figures 1 and 3 passing along a path of travel through an inspection station adjacent the viewing aperture 2 and thence through a slot or narrow passage formed by the nip between two rollers 5 and 6 which are preferably arranged to be rotated. Those skilled in the art will appreciate that the narrow passage may be formed in a number of alternative ways. After passing through this narrow passage, the flattened tubular material is folded on to a reciprocating carriage 7 such that a zig-zag pile or stack is formed.

Preferably, a generally plate-like internal spacer means is provided internally of the flattened tube of material immediately upstream of the aforementioned narrow passage. This plate is arranged to have a height corresponding to the distance between the nip of the rollers and the cradle 3 so that it extends throughout the whole of the inspection region and correctly spaces

the forward and backward edges (as seen by an inspector) of the flattened material so that the whole of the exterior surface of the flattened material may be seen by the viewer simultaneously in a manner which will be explained subsequently. The plate may be made of small thickness, and it is then necessary that the lower-most end of the plate have a portion of greater thickness such that the plate cannot pass through the nip between the rollers. This end portion of greater thickness may be formed by a bar or by a roller which may be journalled to the remainder of the plate so that it can rotate.

As best shown in Figure 2, the light reflecting means are preferably a pair of plane mirrors 8 and 9 at an angle to each other, the path of travel of the tubular material being the plane bisecting the angle between the two mirrors. The mirrors may be joined together at their ends remote from the viewing aperture 2. At their free ends adjacent the viewing aperture, illuminating means for the inspection of the flattened tubular material are provided, for example in the form of tubular fluorescent lamps 10 and 11. By simultaneously looking into the two mirrors 8 and 9, a human inspector will see the entire exterior surface of the length of flattened tubular material in front of the viewing aperture at that time so that he will be able to readily notice any defects. Alternatively, a camera may be mounted in front of the viewing aperture and will, equally, "see" both illuminated sides of the material simultaneously. The colour or brightness of the internal spacing plate may be suitably chosen to provide a strong visual contrast with the colour or brightness of the tubular material itself at any defect.

Illumination can take place internally of the tubular material by mounting a lamp inside the internal spacer means, the lamp being connected to a first coil also mounted on the spacer means, which coil is arranged to cooperate with a coil provided in the region of the inspection station and connected to a source of electrical energy, whereby to feed current inductively to the lamp. It will be readily appreciated that the internal spacing means need not be planar. For example, the plate may be outwardly bowed on one or both sides (which will naturally aid in preventing it passing through the slot or narrow passage) and in such circumstances the tubular material will not be completely flat as it passes through the inspection station; but even under such circumstances both sides of the material will be simultaneously visible to an inspector. Equally well, those skilled in this art will readily appreciate that the light reflecting means may be provided in any number of alternative ways. Also, it is not necessary that the tubular material should pass along a path of travel which is vertically downwards; any desired or appropriate direction of travel may be employed.

WHAT I CLAIM IS:—

1. Apparatus for the inspection of continuous lengths of flexible material in flattened tubular form, the apparatus comprising an inspection station and means defining a path of travel for said material longitudinally therethrough, the inspection station including means for illuminating both sides of the material and light reflecting means so located that both illuminated sides of the material are equally and simultaneously visible to a viewer at a single viewing position.

2. Apparatus according to Claim 1, wherein the means defining said path of travel comprise means upstream of the inspection station for receiving a supply of said material and for delivering said material from the supply to the inspection station, and means defining a narrow passage downstream of the inspection station for the reception and passage therethrough of said material after traversing the inspection station; and wherein means are provided (for operative location internally of the tubular material immediately upstream of the passage) of such dimensions and configuration as to internally space the material whereby any defect may be readily detected, and as to be unable to pass through the passage.

3. Apparatus according to Claim 2, wherein the narrow passage is provided by the nip between a pair of parallel rollers.

4. Apparatus according to Claims 2 or 3, wherein the internal spacer means comprises a plate like member having a portion of greater thickness than the greater part of the plate, which thickness is larger than the width of the said passage.

5. Apparatus according to Claim 4, wherein the said portion consists of a roller journalled to the remainder of the spacer.

6. Apparatus according to any one of Claims 2 to 5, wherein the illuminating means include a lamp fixed to the internal spacer means for the illumination of the tubular material from within, the lamp being electrically connected to a first transformer winding mounted on the internal spacer means and arranged for cooperation with a second transformer winding provided at the inspection station for connection to a source of electrical power.

7. Apparatus according to any one of Claims 2 to 6, wherein the internal spacer means is darkly coloured to provide a strong visual contrast at a defect in a brightly coloured material.

8. Apparatus according to any one of Claims 2 to 6, wherein the internal spacer means is light in colour to provide a strong

the forward and backward edges (as seen by an inspector) of the flattened material so that the whole of the exterior surface of the flattened material may be seen by the viewer simultaneously in a manner which will be explained subsequently. The plate may be made of small thickness, and it is then necessary that the lower-most end of the plate have a portion of greater thickness such that the plate cannot pass through the nip between the rollers. This end portion of greater thickness may be formed by a bar or by a roller which may be journalled to the remainder of the plate so that it can rotate.

As best shown in Figure 2, the light reflecting means are preferably a pair of plane mirrors 8 and 9 at an angle to each other, the path of travel of the tubular material being the plane bisecting the angle between the two mirrors. The mirrors may be joined together at their ends remote from the viewing aperture 2. At their free ends adjacent the viewing aperture, illuminating means for the inspection of the flattened tubular material are provided, for example in the form of tubular fluorescent lamps 10 and 11. By simultaneously looking into the two mirrors 8 and 9, a human inspector will see the entire exterior surface of the length of flattened tubular material in front of the viewing aperture at that time so that he will be able to readily notice any defects. Alternatively, a camera may be mounted in front of the viewing aperture and will, equally, "see" both illuminated sides of the material simultaneously. The colour or brightness of the internal spacing plate may be suitably chosen to provide a strong visual contrast with the colour or brightness of the tubular material itself at any defect.

Illumination can take place internally of the tubular material by mounting a lamp inside the internal spacer means, the lamp being connected to a first coil also mounted on the spacer means, which coil is arranged to cooperate with a coil provided in the region of the inspection station and connected to a source of electrical energy, whereby to feed current inductively to the lamp. It will be readily appreciated that the internal spacing means need not be planar. For example, the plate may be outwardly bowed on one or both sides (which will naturally aid in preventing it passing through the slot or narrow passage) and in such circumstances the tubular material will not be completely flat as it passes through the inspection station; but even under such circumstances both sides of the material will be simultaneously visible to an inspector. Equally well, those skilled in this art will readily appreciate that the light reflecting means may be provided in any number of alternative ways. Also, it is not necessary that the tubular material should pass along a path of travel which is vertically downwards; any desired or appropriate direction of travel may be employed.

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2. Apparatus according to Claim 1, wherein the means defining said path of travel comprise means upstream of the inspection station for receiving a supply of said material and for delivering said material from the supply to the inspection station, and means defining a narrow passage downstream of the inspection station for the reception and passage therethrough of said material after traversing the inspection station; and wherein means are provided (for operative location internally of the tubular material immediately upstream of the passage) of such dimensions and configuration as to internally space the material whereby any defect may be readily detected, and as to be unable to pass through the passage.

3. Apparatus according to Claim 2, wherein the narrow passage is provided by the nip between a pair of parallel rollers.

4. Apparatus according to Claims 2 or 3, wherein the internal spacer means comprises a plate like member having a portion of greater thickness than the greater part of the plate, which thickness is larger than the width of the said passage.

5. Apparatus according to Claim 4, wherein the said portion consists of a roller journalled to the remainder of the spacer.

6. Apparatus according to any one of Claims 2 to 5, wherein the illuminating means include a lamp fixed to the internal spacer means for the illumination of the tubular material from within, the lamp being electrically connected to a first transformer winding mounted on the internal spacer means and arranged for cooperation with a second transformer winding provided at the inspection station for connection to a source of electrical power.

7. Apparatus according to any one of Claims 2 to 6, wherein the internal spacer means is darkly coloured to provide a strong visual contrast at a defect in a brightly coloured material.

8. Apparatus according to any one of Claims 2 to 6, wherein the internal spacer means is light in colour to provide a strong

visual contrast at a defect in a darkly coloured material.

9. Apparatus according to any preceding claim, wherein the reflecting means comprises a pair of plane mirrors at an angle to each other, the path of travel coinciding with the plane bisecting the angle between the mirrors.

10. Apparatus for the inspection of continuous lengths of flexible material in flattened tubular form substantially as hereinbefore described with reference to and as shown in the accompanying drawings.

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