June 13, 1972 J. A. BRISCOE 3,669,552
METHOD AND APPARATUS FOR SPREADING AND COUNTING
FILAMENTS IN A YARN
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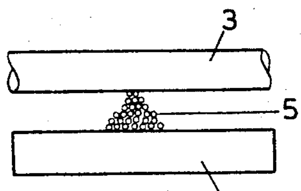

FIG. 1

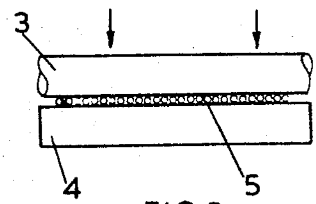

FIG. 3

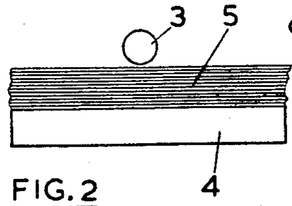

FIG. 2

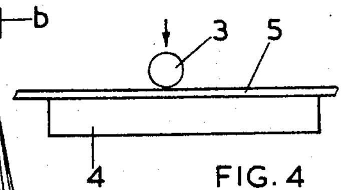

FIG. 4

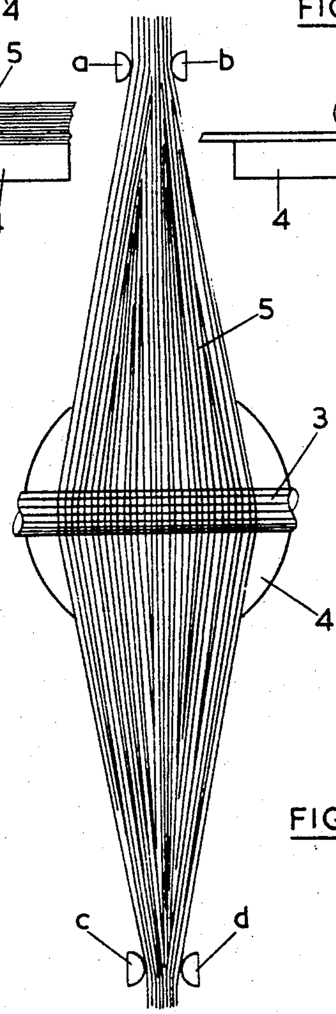

FIG. 5

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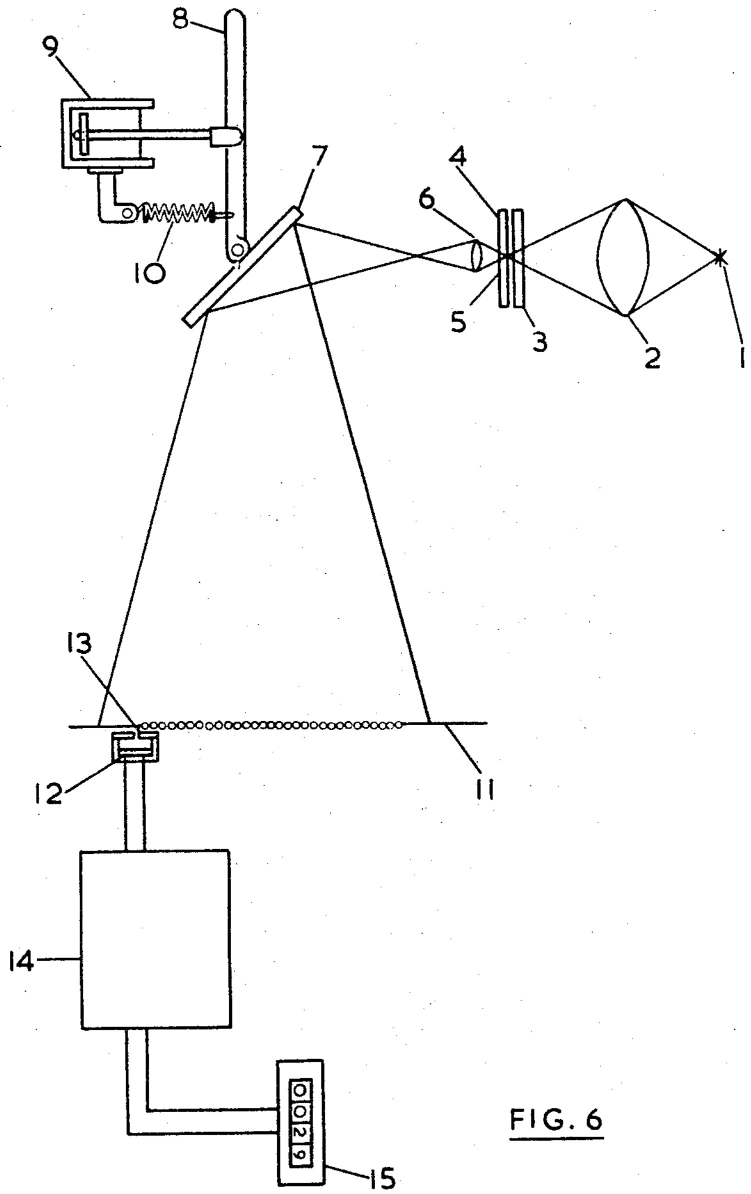

FIG. 6

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1

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METHOD AND APPARATUS FOR SPREADING AND COUNTING FILAMENTS IN A YARN

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Int. Cl. G01n 21/22
U.S. Cl. 356—199 8 Claims

ABSTRACT OF THE DISCLOSURE

A method and apparatus for counting filaments in a yarn by gripping the filaments between smooth surfaces which are capable of making line contact to spread the filaments into a single layer array, which may be checked before counting.

This invention relates to a method and an apparatus for counting filaments in a yarn or bundle.

Several methods have been devised for automatically counting the number of filaments in a yarn. None of these have however proved satisfactory in practice for Works control e.g. in a filament yarn plant, where the yarns are monitored by manual/visual examination. This is tedious, expensive and unreliable. The correct counting of the number of filaments in a yarn quickly and accurately, is of paramount importance e.g. in relation to split and twin-pack spinning, especially if tandem-winding is used so that yarns of equal denier may be obtained.

A new method has now been devised which gives more accurate results than the methods used hitherto.

According to our invention we provide a method of counting filaments in a substantially parallel and twist free bundle, comprising spreading such bundle by gripping it between two smooth surfaces capable of contact along a line and counting the filaments in a sheet-like array so formed.

We also provide an apparatus for counting filaments in a substantially parallel and twist-free bundle with means for counting the filaments comprising means for spreading the filaments, characterised in that two smooth surfaces capable of making contact along a line are used for spreading the filaments.

The smooth surfaces may be provided by a flat plate and a cylindrical curved surface such as a rod or blade—conveniently the plate and the rod should be transparent and in that case glass is a suitable material of construction. Counting of the array of the gripped filaments may then be carried out on a real optical image of the filaments or on one side from the line of grip of the gripping surfaces. For convenience the optical image is enlarged. In a preferred embodiment the projected image is passed over a stationary slit in front of a photoelectric counting device with means for tilting a mirror in the path of the projected image, whilst the clamped filaments in the gripping device also remain stationary. Although counting of the filaments is carried out by photoelectric

2

means in a preferred embodiment of the invention, other means may be used for scanning and counting the filaments in the sheet-like array. A stylus may e.g. be traversed across the filaments and suitably amplified signals from the stylus picked up by electric or acoustic means and recorded on a counter.

A method described in U.K. specification 829,330 using a transducer may also be adapted, but cutting of the individual filaments is not desirable and therefore either the array of filaments is traversed past the transducer pick-up or the pick-up is passed across the array of clamped filaments and the appropriate signals are automatically recorded.

We have found our method suitable for counting undrawn melt spun filaments e.g. those made from nylon or p.e.t. preferably in their dry condition and having substantially round, substantially circular and uniform cross sections, as this assists spreading the filaments in a uniform array. If the filaments are transparent or translucent and if optical means for counting are used, the filaments act as cylindrical lenses and advantage can be taken of this property which counting the shadows so obtained, by photo-electric means as described in greater detail in the preferred embodiment hereafter.

Beams of a wavelength in the visual spectrum are convenient but other wavelengths and radiations can be used provided that sufficient contrast is obtained either by passage through or reflection from each filament in the array and provided that suitable means are provided for recording the contrasting signals from the filaments.

If it is desired to count undrawn opaque black or dark coloured filaments, our apparatus can still be used but a modification of the procedure is required. After clamping the filaments in the usual way between the plate and the glass rod, the bundle of clamped filaments is firmly held at one side of the clamping device, whilst the other side is drawn out, either by hand or by machine. The yarn in the nip remains undrawn and as the filaments lie side by side in the nip, no light is transmitted, and the filaments do not act as cylindrical lenses and no high-lights and shadows are formed. However, as a result of the drawing-down action a region close to the nip is produced where the filaments have a smaller diameter than the undrawn filaments in the nip, and where gaps have formed between the filaments below the nip. Counting of the drawn-down filaments can now be performed by passing the light beam across the filaments below, instead of through the nip, i.e., slightly displaced from the clamping glass rod or blade and thereby illumminating the gaps formed between the drawn-down filaments. Either the shadows cast by the opaque filaments or the illuminated gaps between the filaments can then be counted by photoelectric means. Refocussing of the light beam and adjustment of the sensitivity of the photoelectric circuit are required to cope with the greater light contrast obtained.

A preferred embodiment of our invention is described by reference to the attached drawings in which

FIGS. 1 and 2 are diagrammatic sectional front and side views respectively, of surfaces for gripping the yarn, in their "open" position.

FIGS. 3, 4 and 5 are diagrammatic front, side and plan views respectively of the gripping surfaces in the "gripping" position with the yarn and showing the yarn guides in FIG. 5.

FIG. 6 is a schematic diagram of the apparatus for counting the gripped filaments.

Our static method is applied to a finite sample length of the yarn comprising placing the yarn between a flat glass plate **4** and a cylindrical curved surface, preferably a glass rod **3**, and also shown in FIGS. 3 and 4. When the rod **3** is pressed firmly against the plate **4**, the bundle of filaments **5** (FIG. 1) is nipped between the plate and rod and surprisingly, is spread out evenly and the filaments come to lie in contact side by side as shown at **5** in FIG. 3.

The yarn is located in U guides, *a*, *b* and *c*, *d* on either side of the rod/plate assembly (FIG. 5) and the spreading action of the nip on the yarn together with the containing action of the two guides causes the filaments to sit side-by-side closely adjacent to one another. The lateral position of the filaments is also controlled precisely by the guides *a*, *b* and *c*, *d* so that a simple optical system can be used to project an image of the parallel filaments in the nip between the plate **4** and the rod **3** onto a screen. This image enables the user of the equipment to check visually that the filaments are properly arrayed (i.e. no cross-overs or spaces between filaments are formed). A photo-electric scanning/counting system is then used to count the filaments in the projected image.

An instrument for counting filaments of spun yarn, (particularly the spun yarn from tandem wind-up spinning machines, for 150/30 bulked knitting yarn) is shown diagrammatically in FIG. 6.

A light source **1**, using a 4 volt 3 watt lamp (Mazda G. 29) having a lamp filament in the form of a single cylindrical coil was found to have the greatest light efficiency when the axis of the lamp filament was parallel with the axis of the glass rod **3**. Accordingly the lamp was adjusted into that position and plano-convex condenser lens **2**, concentrated the light on the yarn **5**, nipped, as described previously in FIGS. **1**, 2, 3, 4 and 5 between the glass rod **3** and a glass plate **4**. A lever arrangement (not shown) enabled the user to raise the glass rod **3**, with a parallel motion, relative to the glass plate **4**, so that the yarn sample could be inserted in the nip between the rod and plate. The pressure in the nip could be maintained by leaf springs.

The lens **6**, represents a microscope nosepiece (C. Baker, 2694) which projects the image of the yarn via a mirror **7**, on to a ground glass screen **11**. The mirror **7**, is pivoted, and the angle of the mirror, and thereby the position of the image on the screen, can be controlled by means of a lever **8**. After such manual movement the mirror is restored to its original position smoothly and steadily, controlled by a dashpot **9**, and a spring **10**. (In this diagram a liquid dashpot is shown, but in the present instrument a mechanical delay movement is used. This produces the same effect as a liquid dashpot, but comprises a gear train and an escapement movement.) A photocell **12**, responds to the light and shade of the image of the filaments, as these traverse a slit **13** in front of the photocell and having a width of about equal dimensions as the enlarged image of one filament width as described hereunder. The signals produced are processed in an electronic amplifier **14** and applied to an electromagnetic counter **15**.

When the filaments are transparent or are semi-transparent and cylindrical in form, each filament acts as a cylindrical lens, and its image on the screen comprises a bright central portion bordered on each side by a darker shadow. When the filaments are side by side and lie all closely adjacent to one another, the border shadows of the adjacent filaments combine to produce a single larger shadow, and the width of the slit **13** is adjusted so that a minimum of light reaches the photocell when this combined shadow covers the slit. For a **30**-filament undrawn yarn there are **29** such combined shadows, and two smaller shadows produced by the outer edges of the first and last filaments. These smaller shadows are not sufficiently wide to cover the slit completely and therefore the signal produced by the photocell corresponding to these shadows is small, and the amplifier and counter can be adjusted so that these shadows are ignored.

An automatic switching arrangement, not shown, is incorporated, which sets the counter to zero when the lever **8**, is manually operated, and the counter counts the shadows as the image returns to normal under the control of the spring and dashpot.

The operator, after inserting the sample, can inspect the image on the screen, and can decide whether the filaments are correctly aligned. If there are spaces between filaments or any other disarrangement, another sample will be placed between the rod and plate. The lever attached to the mirror is then operated, which automatically zeros the counted. The number of filaments, less one, will within seconds, be displayed on the counter.

It will be appreciated that other means for counting the filaments in the sheet-like array may be used as already indicated.

Filaments of non-circular cross sections may also be counted by the optical method as used for opaque filaments, provided that a visual check is made to ensure that the filaments do not cross-over or lie on top of each other, before switching on the automatic counting device and when the filaments are in a suitable array according to the invention.

What I claim is:

1. A method of counting filaments in a substantially parallel and twist-free bundle comprising: spreading the bundle into a sheetlike, side-by-side array of filaments by gripping the bundle between a structure having a smooth flat transparent surface and another structure having a curved smooth transparent surface capable of making contact with the flat surface along a line; projecting a first light beam toward said array of filaments to produce a second beam of light having variations in light intensity in correspondence with the positions of the individual filaments in said array; producing relative motion between the second beam of light and at least one photocell which is responsive to said variations in light intensity to produce an electrical output signal having variations corresponding to the individual filaments; and detecting and counting the number of variations in the output signal to effectively count the number of individual filaments in said array.

2. A method as in claim **1** wherein the filaments are undrawn opaque filaments, said method comprising drawing down the filaments in the side-by-side array of filaments to produce gaps between the drawn-down filaments whereby said first beam of light passes through the gaps thereby forming said second beam of light.

3. A method as in claim **1** wherein said second beam of light is passed through a lens to form an enlarged optical image of the filaments and then on to a mirror, and wherein the step of producing relative motion is carried out by tilting the mirror so that the enlarged images are traversed past a stationary photocell.

4. A method as in claim **1** wherein the structure having the curved surface is a cylindrical transparent rod serving as a cylindrical lens, and wherein said first beam of light is projected through said rod.

5. A method as in claim **1** wherein the filaments are transparent or translucent so that they act as cylindrical lenses with respect to said first beam of light.

6. Apparatus for counting the filaments in a substantially parallel twist-free bundle comprising: nip means for gripping and spreading the filaments into a sheetlike, side-by-side array of filaments, said means including a transparent plate having a smooth flat surface and a structure having a curved smooth surface capable of making contact with the flat surface along a line; means for projecting a light beam through the plate and through the filaments to produce a second light beam having variations in light intensity in correspondence with the positions of the individual filaments in the array; a photoelectric counter including a photocell which is responsive to changes in light intensity to produce an electric output signal having variations corresponding to the variations in the second light beam; and means for producing relative traversing movement between the second light beam and said photocell.

7. Apparatus as in claim **6** wherein said plate and said structure having a curved surface are made of glass.

8. Apparatus as in claim **6** including a lens which forms the second beam of light into a magnified image of the array of filaments.

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U.S. Cl. X.R.

73—159; 250—219 S; 356—238