

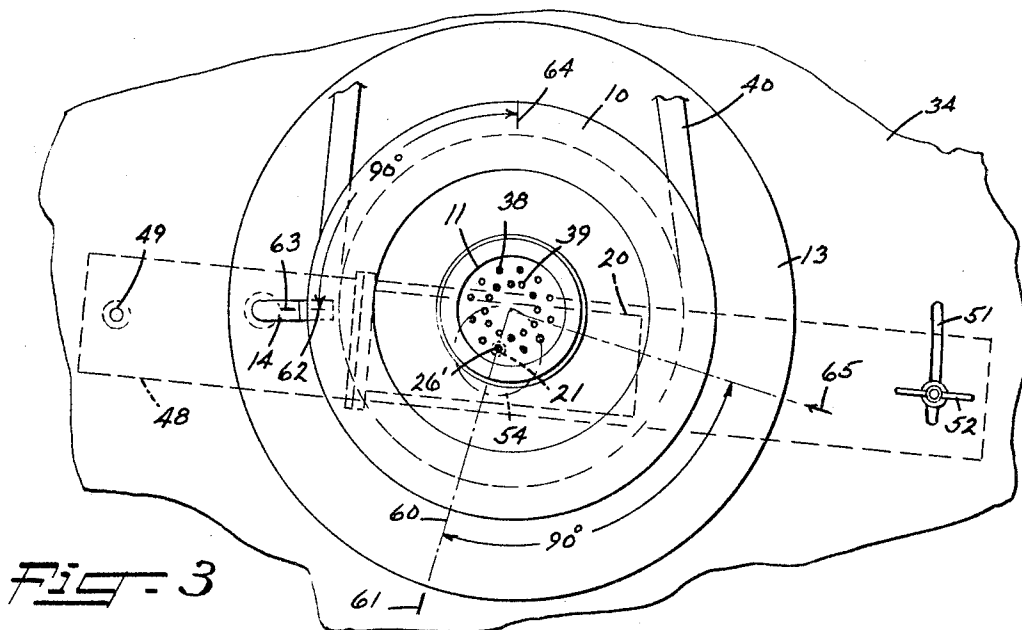
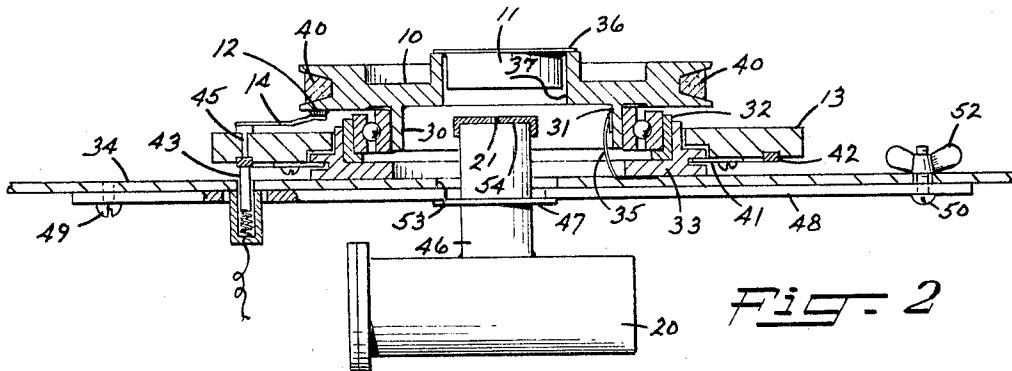
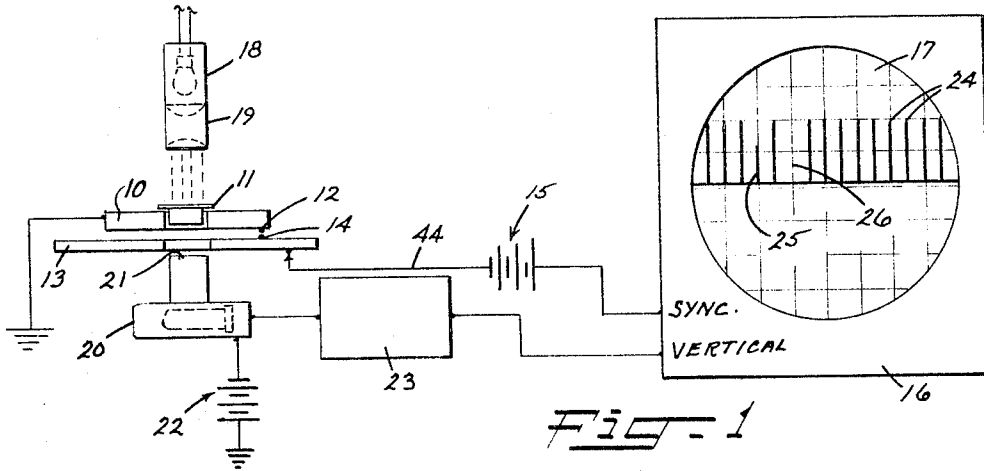
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METHOD AND APPARATUS FOR INSPECTING SPINNERETS

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1

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METHOD AND APPARATUS FOR INSPECTING SPINNERETS

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This invention relates to an improved method and apparatus for inspecting spinnerets of the type used for spinning artificial or synthetic yarn filaments and more particularly to an improved means for expeditiously locating defective or clogged holes in such spinnerets.

Spinnerets or jets employed in spinning artificial or synthetic yarn filaments vary somewhat in construction depending upon the fiber forming material and the overall process. The present invention is particularly applicable to the inspection of spinnerets used for spinning acetate filaments. Such spinnerets are cup shaped members generally about an inch in diameter and provided with anywhere from about ten to a hundred or more holes arranged either in a single circle or in a pair of concentric circles, the holes of each circle being usually but not necessarily evenly spaced from one another. The holes are extremely small, having a diameter of from about one and one-half thousandths of an inch to about two and one-half thousandths, depending upon the nature of the spinning solution and the denier of the filaments to be spun. In a production facility it is not uncommon for one or more of the holes to become clogged, with the result that the desired number of filaments is not produced, or defective filaments may be formed if the hole is only partially blocked. It is therefore customary to remove the spinnerets from the spinning machines periodically for cleaning and inspection. While it can usually be rather readily determined whether the spinneret in fact has a clogged hole by observing the action during spinning, the location of the particular clogged hole or holes has been difficult.

Since the holes are too small to be observed accurately by normal visual means, various inspection schemes have been devised. One method has been to project a diffused image of the holes on a screen. Another is to hold the spinneret against a diffused light and observe directly the light passing through the holes. While both these methods are quick and inexpensive, they require an experienced operator, particularly in detecting holes which are only partially clogged. The most reliable but also the most expensive method of detecting and locating clogged holes is by microscopic examination. This latter method is particularly wasteful of energy inasmuch as almost all holes examined are in good condition and yet the time spent in looking at a good hole is almost as great as in looking at one of the few which may be fully or partially clogged or plugged. The present invention is intended to facilitate microscopic examination by locating the particular holes which need to be examined and repaired or cleaned.

It is an object of the invention to provide an improved method of detecting and locating a clogged hole in a spinneret.

It is a more specific object to provide a method of locating a clogged spinneret hole which method is fast, accurate and does not require a high degree of skill or experience to execute.

A further object of the invention is to provide improved apparatus for quickly and accurately locating clogged spinneret holes to thereby facilitate microscopic inspection.

Other and further objects, features and advantages of the invention as well as the means for attaining the

2

same will become apparent as the description of a preferred embodiment thereof proceeds.

Before referring to the drawing, the novel method will then become apparent as the apparatus is described. The spinneret is mounted in a holder in such way that light may be directed through the spinneret holes to impinge upon a light sensitive photo-electric cell. The cell is shielded so that the only light striking it must pass through a spinneret hole which is in a particular preselected position. The holder is then rotated at substantially constant speed about the axis of the circular arrangement of holes in the spinneret whereby each hole is repeatedly moved through the preselected position which admits light to the photo-electric cell. The cell is connected through an amplifier to the vertical input of a cathode ray oscilloscope having an externally triggerable horizontal sweep circuit. The sweep circuit is triggered by the spinneret holder once during each revolution of the holder whereby the screen of the oscilloscope displays a series of vertical pulses representing the condition of the spinneret holes as they pass through the preselected position, the pulse representing the hole which is in the preselected position at the time of the start of the sweep appearing at the extreme left of the pulse pattern. Completely clogged holes are indicated on the oscilloscope screen as missing pulses and partially clogged holes show up as abnormally short pulses. By varying the rotated position in which the spinneret holder triggers the horizontal sweep until a clogged hole is in the preselected position at the time of starting the sweep, the clogged hole may be readily found by stopping the rotation of the holder and then returning the holder manually to the rotated position in which it triggered the horizontal sweep of the oscilloscope. With the holder in the position in which it triggered the sweep, the clogged hole is in the preselected position. The rotated position in which the holder triggered the horizontal sweep is made known to the operator by suitable indicia, as will be explained.

Referring now to the drawing:

FIG. 1 is a diagrammatic view of the apparatus;

FIG. 2 is a vertical section of a portion of the apparatus; and

FIG. 3 is a plan view of that portion of the apparatus shown in section in FIG. 2.

As shown diagrammatically in FIG. 1, the apparatus comprises an annular turntable or support 10 having an axial opening within which the spinneret 11 is supported. Support 10 is grounded and is provided underneath at one point near the periphery thereof with a downwardly protruding electrical contact 12. As will presently be explained, means is provided for rotating support 10 at substantially constant speed. Mounted beneath support 10 for manual rotation about the axis of said support is an annular member or turntable 13 having on its upper face a contact 14 which is engaged by the contact 12 once during each revolution of support 10. Contact 14 is connected through a slip ring to a D.C. power supply such as a battery 15. One side of battery 15 is connected to an externally triggerable horizontal sweep circuit of a cathode ray oscilloscope 16. The terminal where the powered circuit is connected to the oscilloscope is usually marked "sync" and the purpose of this connection is to time the start of the movement of the electron beam of the oscilloscope across the fluorescent screen 17 thereof. Thus a horizontal sweep, normally from left to right, of the oscilloscope beam is triggered or begun each time contact 12 engages contact 14 to close the circuit through battery 15.

3

Located above the spinneret is a light source 13 and a lines 19 directs parallel light rays against the back face of the spinneret so that the light will pass through the spinneret holes which as previously mentioned are arranged in one or more concentric circles. Located beneath the two turntables 10 and 13 and in line with the central openings thereof is a photo-electric cell 20 which is shielded so that the only light reaching the cell must pass through an aperture 21. Aperture 21 is spaced radially from the central axis of the spinneret the same distance as the spinneret holes and is of such size that only one spinneret hole at a time is aligned therewith. As support 10 is rotated each hole of the spinneret becomes repeatedly aligned with the aperture 21 to thus permit flashes of light from the source 13 to impinge upon cell 20. The previously referred to "preselected position" of a spinneret hole is the position in which the hole is aligned with aperture 21.

Direct current is supplied to cell 20 from a suitable source such as a battery 22 and the cell is light sensitive and arranged to pass current when struck by light. Cell 20 is connected through an amplifier 23 to the vertical input of the oscilloscope. Thus each time an unplugged spinneret hole passes through the preselected position to admit light to cell 20, the electron beam of the oscilloscope is vertically deflected so that the amount of light passing through the holes and hence the condition of the holes is represented on the fluorescent screen as a series of pulses spaced in the same manner as the spacing of holes in the spinneret. In FIG. 1 long pulses 24 represent good or completely unplugged spinneret holes. A partially plugged hole is represented by a short pulse 25 and a completely plugged hole is indicated at position 26 where a pulse is completely missing. As previously mentioned the horizontal sweep from left to right of the oscilloscope beam is triggered when contacts 12 and 14 engage and thus in FIG. 1 a long pulse at the left of the screen indicates that at the time of engagement of contacts 12 and 14 an unplugged hole is in the preselected position of alignment with aperture 21. By manually rotating member 13 with its contact 14 the time of triggering the horizontal sweep is varied and when the missing pulse 26 or the short pulse 25 appears at the beginning of the horizontal sweep it is known that the completely or partially plugged hole is in the preselected position at the time of contact between contacts 12 and 14. After stopping the rotation of spinneret holder 10, said holder may be manually turned to again bring the contacts 12 and 14 into alignment whereby the partially or completely plugged hole is relocated in the preselected position. By means of suitable indicia, as will be explained, the plugged hole may be brought to any desired rotated position.

Referring now particularly to FIGS. 2 and 3, the spinneret holder 10 is provided with an axially extending flange 30 which fits into the inner race of ball bearing 31. The outer race of bearing 31 is supported in an insulating sleeve 32 fitted within an annular member 33 suitably secured to a table 34. Holder 10 is grounded to table 34 through a lead 35. Spinneret 11, as is usual, has an annular flange 36 by means of which it is supported within an axial opening 37 of holder 10. The spinneret shown in the drawing has two concentric circles of holes the outer holes being indicated at 38 and the inner ones at 39. When the spinneret is positioned within the holder, the center of the circles of holes 38 and 39 coincides with the axis of rotation of the holder. Holder 10 is provided with a peripheral groove within which is engaged a drive belt 40 driven by a suitable motor, not shown, by means of which the holder may be rotated at constant speed.

Manually rotatable member 13 is formed of electrically non-conductive material and has secured thereto a plurality of arcuate members 41 which fit within a peripheral groove provided in annular member 33. Thus member 13 may be rotated independently of the spinneret holder

4

10. Secured to the under side of member 13 is a slip ring 42 engaging which is a brush 43 connected by a lead 44 to the battery 15. Slip ring 42 is connected by an electrically conductive rivet 45 to the contact 14 which extends inward as best shown in FIG. 2 so as to be in the path of movement of contact 12.

Photo-electric tube or cell 20 has a neck portion 46 which is secured by a collar 47 to a lever 48 pivotally connected at 49 to the under side of table 34. A bolt 50 connected to lever 48 extends through an arcuate slot 51 in the table and a winged locking nut 52 is provided for locking lever 48 in various adjusted positions permitted by slot 51. The neck 46 extends upward through an opening 53 in the table and at its upper end is provided with a cap or a shield 54 having the aforementioned aperture 21 through which light must pass in order to energize cell 20. Preferably shield 54 is located fairly close to the face of the spinneret. In FIG. 3, aperture 21 is shown aligned with the outer circle of holes 38 and it will be apparent that by swinging lever 48 a small distance counterclockwise about pivot 49 said aperture may be moved into alignment with the inner circle of holes 39. If the device is to be used only with spinnerets having a single circle of holes the adjustable mounting of cell 20 may be omitted and if it is to be used with spinnerets all of which have the same spacing of the two circles of holes, slot 51 can be made of such length that the aperture 21 will be aligned with one or the other circles of holes merely by moving bolt 50 to one end or the other of the slot.

In FIG. 3 a hole 26' is shown in the aforementioned preselected position of alignment with aperture 21 and for purposes of explanation it will be noted that hole 26' and aperture 21 lie on a radius line 60 of the spinneret. If desired, an indicia mark 61 may be provided on table 34 so that the radial alignment of the preselected position will be known. As the spinneret is rotated each of the holes 38 of the outer circle of holes is moved repeatedly through the preselected position over aperture 21. Assuming that hole 26' is completely plugged, this condition will appear on the screen of the oscilloscope as the missing pulse 26 and as previously explained if the missing pulse is at the extreme left of the screen, contacts 12 and 14 are closed at the time said plugged hole is in the preselected position as shown in FIG. 3. Since contact 12 is beneath the holder 10, an indicating mark 62 may be provided on the top of the holder in alignment with said contact and in FIG. 3 it will be noted that the mark 62 is aligned with contact 14 which is visible but may, if desired, also be provided with an indicating mark as shown at 63.

After manually rotating disk 13 to the FIG. 3 position to locate the missing pulse at the extreme left of the oscilloscope screen, the motor driving belt 40 is shut off and turntable 10 is manually rotated to align the mark 62 with the line 63 of contact 14. The plugged hole 26' will then be in alignment with the indicia mark 61. It may be that when the plugged hole is aligned with mark 61, it is not in the most convenient position for examination and by providing suitable indicia on turntables 10 and 13 it is possible to locate the plugged hole in any rotated position. For example if it is desired to have the plugged hole located 90° counterclockwise from the radius line 60, an indicating mark 64 may be provided on turntable 10 at a point displaced 90° clockwise from mark 62 and contact 12. Then by manually rotating turntable 10 until mark 64 is aligned with indicating mark 63 of contact 14, the plugged hole 26' is moved to the desired position which may be indicated on table 34 by a suitable mark 65. Obviously mark 63 need not be located on contact 14. For example if mark 63 is displaced 30° clockwise from contact 14, then the mark 64 will be displaced 90° and 30° or 120° clockwise from the contact 12 in order to locate the defective hole in alignment with mark 65 when mark 64 is moved into alignment with mark 63.

5

6

It will be apparent that the details of construction of the apparatus may be changed substantially without departing from the essence of the invention and it is to be understood that the scope of the invention is limited only by the appended claims.

What is claimed is:

1. Apparatus for locating a clogged hole in a spinneret having a circular arrangement of holes, said apparatus comprising a rotatable support for supporting the spinneret for rotation therewith about the axis of the circular arrangement of holes, a light source for directing light through the holes of the spinneret, a light sensitive cell responsive to light from said source, a shield between said light source and said cell, said shield limiting the light reaching said cell to the light passing through a hole located in a preselected position, means for rotating said support at substantially constant speed to thereby repeatedly move each hole of the spinneret through said preselected position, a cathode ray oscilloscope having a vertical beam deflecting circuit and a triggerable horizontal sweep circuit, means connecting said light sensitive cell to the vertical beam deflecting circuit of said oscilloscope whereby said cell activates the vertical beam deflecting circuit when an unclogged hole passes through said preselected position and is ineffective when a completely clogged hole passes through said preselected position, a first electrical contact on said rotatable support, a second electrical contact arranged to be engaged by said first contact once during each revolution of said support, a powered circuit including said electrical contacts connected to said oscilloscope to trigger the horizontal sweep circuit thereof each time said contacts engage whereby the horizontal starting position of the beam of the oscilloscope is determined by the hole which is in said preselected position at the time said contacts engage one another, means mounting said second electrical contact for manual rotation about the axis of said rotatable support whereby said contacts may be caused to engage at the time a clogged hole is in the preselected position, and means for indicating the rotary position of the clogged hole in relation to said preselected position.

2. The apparatus set forth in claim 1 wherein the last mentioned means comprises a mark on said rotatable support and a mark on the means mounting said second electrical contact, said marks being related to the contacts in such a way that if the clogged hole is in said preselected position when the contacts are engaged it may be moved to another preselected position by manually rotating said rotatable support until said marks are radially aligned.

3. Apparatus for locating a clogged hole in a spinneret having a circular arrangement of holes, said apparatus comprising a rotatable support for supporting the spinneret for rotation therewith about the axis of the circular arrangement of holes, a light source for directing light through the holes of the spinneret, a light sensitive cell responsive to light from said source, a shield between said light source and said cell, said shield limiting the light reaching said cell to the light passing through a hole located in a preselected position, means for rotating said support at substantially constant speed to thereby repeatedly move each hole of the spinneret through said preselected position, a cathode ray oscilloscope having a vertical beam deflecting circuit and a triggerable horizontal sweep circuit, a first electrical contact on said rotatable support, a second electrical contact arranged to be contacted by said first contact once during each revolution of said support, a powered circuit including said electrical contacts connected to said oscilloscope to trigger the horizontal sweep circuit of the oscilloscope each time said contacts engage, means connecting said light sensitive cell to the vertical beam deflecting circuit of said oscilloscope, manually movable means for adjusting the position of said second electrical contact so as to vary the time of triggering the horizontal sweep

circuit whereby the horizontal sweep may be caused to begin when a plugged hole is in said preselected position, indicia on said rotatable support having a known angular relationship to said first electrical contact, and indicia on said manually movable means having a known angular relationship to said second electrical contact whereby the desired rotated position of the clogged hole may be obtained by aligning said indicia.

4. Apparatus for locating a clogged hole in a spinneret having a circular arrangement of holes, said apparatus comprising a rotatable support for supporting the spinneret for rotation therewith about the axis of the circular arrangement of holes, a light source for directing light through the holes of the spinneret, a light sensitive cell responsive to light from said source, a shield between said light source and said cell, said shield limiting the light reaching said cell to the light passing through a hole located in a preselected position, means for rotating said support at substantially constant speed to thereby repeatedly move each hole of the spinneret through said preselected position, a cathode ray oscilloscope having a vertical beam deflecting circuit and a triggerable horizontal sweep circuit, a first electrical contact on said rotatable support, a second electrical contact arranged to be contacted by said first contact once during each revolution of said support, a powered circuit including said electrical contacts connected to said oscilloscope to trigger the horizontal sweep circuit thereof each time said contacts engage, means connecting said light sensitive cell to the vertical beam deflecting circuit of said oscilloscope, said oscilloscope having a fluorescent screen for displaying the trace of the beam which appears as a series of evenly spaced vertical pulses the height of which is proportioned to the amount of light passing through the spinneret holes as they pass through said preselected position, the pulse representing the hole which is in the preselected position, the pulse representing the hole which is in the preselected position at the time said first electrical contact engages said second electrical contact appearing at an extreme end of the trace, manually movable means for adjusting the position of said second electrical contact so as to cause the pulse representing a clogged hole to appear at the extreme end of the trace, indicia on said rotatable support having a known angular relationship to said first electrical contact, and indicia on said manually movable means having a known relationship to said second electrical contact whereby the desired rotated position of the clogged hole may be obtained by aligning said indicia.

5. Apparatus for locating a clogged hole in a spinneret having a circular arrangement of holes, said apparatus comprising a rotatably mounted annular support for supporting a spinneret with the holes of the spinneret concentric with the axis of rotation of said support, a light source for directing light through the holes of the spinneret, a light sensitive cell responsive to light from said source, a shield between said light source and said cell, said shield limiting the light reaching said cell to the light passing through a hole located in a preselected position, means for rotating said support at substantially constant speed to thereby repeatedly move each hole of the spinneret through said preselected position, a cathode ray oscilloscope having a vertical beam deflecting circuit and a triggerable horizontal sweep circuit, means connecting said light sensitive cell to the vertical beam deflecting circuit of said oscilloscope whereby the vertical deflection of the oscilloscope beam is controlled by the amount of light passing through a spinneret hole located in the preselected position, a first circuit closing element mounted on said rotatable support, a second circuit closing element mounted in position to be cooperatively aligned with said first element once during each revolution of said support, a powered circuit connected to said oscilloscope to trigger the horizontal sweep circuit whenever said circuit closing elements are cooperatively

aligned, means supporting said second circuit closing element for manual rotation about the axis of said rotatable support whereby the triggering of the horizontal sweep circuit of the oscilloscope may be adjusted to the time that a clogged hole is located in the preselected position, and indicia on said rotatable support and said means supporting said second circuit closing element, said indicia when aligned with one another indicating the location of the clogged hole with respect to said preselected position.

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