Apparatus and process are disclosed for controlling yarn plug location in a stuffer tube of a steam jet texturing device near at least one port near the discharge end of the stuffer tube. The port issues a jet of fluid, such as air. Back pressure of the jet of fluid as it impinges on the yarn indicates the presence or absence of the yarn plug beneath the port. Each port communicates with a pressure sensor controller which actuates a control valve which controls the flow of steam to the steam jet. 

14 Claims, 10 Drawing Figures
1 ELECTRONIC-PNEUMATIC YARN PLUG CONTROL SYSTEM FOR YARN TEXTURING DEVICE

CROSS REFERENCE TO RELATION APPLICATION

This application is a continuation-in-part of Ser. No. 239,176, filed Mar. 29, 1972, abandoned on filing of this application.

BACKGROUND OF THE INVENTION

This invention relates to yarn texturing devices, more specifically, a yarn plug control system for yarn texturing devices.

Texturing yarn by directing heated yarn in a current of heated fluid such as steam against a yarn plug in a stuffer tube and discharging the yarn is known in the art. For example, see U. S. Pat. No. 3,409,956 to Longbottom et al., hereby incorporated by reference. In stuffer box crimping, sensing of the yarn plug in the stuffer box is also well known, either to control wind-up speed or to control feed roll speed. For example, see U. S. Pat. No. 3,200,466 to Duga et al., U. S. Pat. No. 3,280,444 and U. S. Pat. No. 3,388,440, both to Stanley. However, none of these prior art patents teach the control of the heated fluid (such as steam) by means of sensing back pressure of a fluid jet issuing from one or more ports near the discharge end of a stuffer tube to control yarn plug location.

SUMMARY OF THE INVENTION

The process of this invention is the improvement of plug control when texturing yarn by directing heated yarn in a current of heated fluid against a yarn plug in a stuffer tube and discharging the yarn. The improvement comprises controlling the location of the end of the yarn plug at the discharge end of the stuffer tube by sensing the plug end location with at least one jet of fluid issuing from at least one port near the discharge end of the stuffer tube. Each port communicates with a pressure sensor controller which actuates a control valve which in turn controls the flow of the heated fluid such as steam. The jets of fluid are preferably air. The heated fluid is preferably steam.

The apparatus of this invention controls the location of a plug of textured yarn near the discharge of a stuffer tube, yarn being textured as described above. The apparatus comprises (a) a stuffer tube having (b) at least one port, issuing a jet of fluid, preferably air. Each port communicates with (c) a pressure sensor controller, so that when the yarn plug is located to be impinged by the jet of fluid issuing from the port, the resulting back pressure can be sensed by the pressure sensor controller. Also, there is (d) means to transmit the output from the pressure sensor controller to actuate a (e) flow control means (such as a valve) in (f) the heated fluid supply means such as a steam line. By pressure sensor controller is meant any kind of electrical, electronic, pneumatic, fluid or other type of pressure sensitive control device such as, preferably, a fluidic amplifier with fixed gain, adjustable bias and rate controlled output relay, or pressure sensor switches, or pneumatic gauging devices.

Thus, the yarn plug end is located near the port or ports in the stuffer tube by controlling the flow of heated fluid (steam) supply means responsive to the back pressure of the fluid jet issuing from the port.

In the preferred embodiment of this invention, the pressure sensor controller is a fluidic amplifier with fixed gain, adjustable bias and rate controlled output relay, commercially available from General Electric Corporation. Two ports in the side of the stuffer tube near the discharge end communicate through a manifold having multiple orifices, preferably five, to the inside of the stuffer tube. The ports are arranged with one near the discharge end of the stuffer tube and one only slightly farther away from the discharge end. The port nearest the discharge end is connected to the controller. The other port is connected to a source of constant pressure air (0.01 to 1 psi). The variance in the back pressure is sensed through the near port and communicated through the connecting air conduit to the controller, which in turn regulates the steam control valve on the steam line to the stuffer tube. Thus, variance in the yarn plug location near the ports is sensed and controlled by continuous proportional changes in the valve in the steam line.

In another port embodiment, a pressure sensor switch connected to the port nearest the discharge end is set so that the back pressure should indicate no yarn plug in front of the port. Back pressure occurs when the yarn plug appears before the port, the pressure sensor switch then actuates the control valve to control the steam flow to cause the plug to retract. The pressure sensor switch connected to the port furthest from the discharge end of the stuffer tube is set to be actuated only when the yarn plug is absent from in front of the port. This pressure sensor switch would also actuate the steam control valve in the steam line to correct the steam flow and bring the plug back in front of the port if the plug should get too short.

In one port embodiment of this invention another control set up is used. Only one port is present in the stuffer tube. This port communicates to a pneumatic gauging device such as the G. E. Qualiguard control unit. The gauging device is set to send signals when the back pressure occurs above or below certain pre-set limits. Thus, as the yarn moves in and out from beneath the single port and back pressure changes, signals sent from the control pneumatic gauging device can drive a servo motor to open or close the steam valve in the control line in either direction to control the location of the yarn plug in the stuffer tube. This single port can also be external to the stuffer tube to sense the yarn plug as it exits beyond the discharge end of the stuffer tube. The single port can also be recessed in the stuffer tube and elongated, or recessed in the stuffer tube and communicating with the stuffer tube through a manifold having a series of hole orifices opening into the stuffer tube.

The process is preferably run at constant yarn removal rates from the plug. These apparatus and method give good plug control and offer no impediments to catch yarn filaments.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic showing the two port embodiment of the pneumatic-electronic plug location control device of this invention.

FIG. 2 is a schematic showing a one port embodiment of the plug location control device of this invention with the port external to the end of the stuffer tube.

FIG. 3 is a schematic showing another one port embodiment.
FIG. 4 is a side view in cross section of a single port embodiment where the port is recessed in the stuffer tube and communicates to the stuffer tube through a manifold having a series of orifices opening into the stuffer tube.  

FIG. 5 is a cross sectional side view of the single port embodiment where the port is elongated longitudinally. 

FIG. 6 is also a cross sectional bottom view of this same embodiment. 

FIG. 7 is also a cross sectional bottom view of this same elongated port. 

FIG. 8 is a schematic showing the preferred proportional pressure sensor controller plug control device of this invention used in the preferred two port embodiment. 

FIG. 9 is a side view in cross section of the preferred recessed ports with manifold and orifices used in conjunction with the controller system in FIG. 8. 

FIG. 10 is a cross sectional bottom view of the ports, manifold and orifices of FIG. 9. 

DESCRIPTION OF THE PREFERRED EMBODIMENT 

Referring to FIG. 1, yarn plug 1 in stuffer tube 2 is formed by impinging yarn on the plug 1 from steam line 3. Details, not important to this invention, can be seen in the Longbottom U. S. Pat. No. 3,409,356. Steam flow is controlled by control valve 4. The end of yarn plug 1 is located between ports 5 and 6 which have jets of fluid such as air issuing from them supplied by air lines 9 and 10. Air lines 9 and 10 communicate with pressure sensor switches 7 and 8. Air is supplied to pressure sensor switches through air line 12 and to lines 9 and 10 through air line 11. Air supply 19 supplies air for line 13 and line 12 to the pressure sensor switches through pressure regulator 16. Air is supplied to air line 11 through regulator 17 from air supply line 13. Air pressure is indicated on pressure gauges 14 and 15. The electronic output of pressure sensor switches 7 and 8 is transmitted through electric lines 28 to control box 24. Control box 24 is supplied electricity through 110 volt AC supply lines 26. Switch box 25 can be used to switch to manual control or set for automatic control and is connected to control box 24 with electric lines 27. Control box 24 is connected to servo drive 20 through pressure switches 21 and 22 with electric lines 29. Servo drive 20 drives valve stem 18 to control steam pressure. Pressure switches 21 and 22 are connected by steam lines 23 to steam line 3 to override signal from control box 24 if pressure in steam line 3 exceeds pre-set limits, i.e., becomes too high or too low. 

Referring to FIG. 2, yarn plug 1 in stuffer tube 2 is formed by impinging yarn on plug 1 from steam line 3 as shown in detail in the Longbottom patent, U. S. 3,409,356. Location of yarn plug 1 is sensed by fluidic proximity sensor 41 having port 47. Air is supplied through line 50 to proximity sensor 41 and back pressure is sensed through line 49 by pressure switch 44. Air is supplied through line 51 to air solenoid valve 46 through air line 52 and through pressure regulator 53 and pressure control 43 to the pressure switch 44 and through line 50 to the proximity sensor 41. Pressure sensor switch 44 output signal is transmitted through electric line 54 to delay timer 45 which in turn emits a control signal through electric line 55 to air solenoid valve 46 which controls control air pressure through line 42 to steam control valve 4 thereby controlling opening and closing of control valve 4 to control steam flow which in turn controls plug location of yarn plug 1. The delay timer 45 is necessary to prevent rapid fluctuation in signals from sensor 41 causing fluttering valve action at control valve 4. 

Referring to FIG. 3, yarn plug 1 in stuffer tube 2 is formed by impinging yarn on plug 1 from steam line 3. Details of the texturing, not important to this invention, can be seen in the Longbottom U. S. Pat. No. 3,409,356. Steam flow is controlled by control valve 4. Yarn plug 1 is located in the area in front of port 35 which has a jet of fluid such as air issuing from it supplied by air line 36. Air line 36 has a reservoir 33 connected by line 34 to dump out surges. Back pressure through line 36 from port 35 due to changes in position of yarn plug 1 is sensed in pneumatic gauging device 31 (G. E. Qualiguard Control Unit). The device functions as a pressure sensor switch. Pneumatic gauging device 31 is set to transmit separate signals when back pressure exceeds upper and lower limits too high or too low. These signals are transmitted through electric line 39 to servo motor 20 which drives valve stem 18 to open and close control valve 4 to control steam flow and in turn adjust position of steam plug 1. Pneumatic gauging device 31 also communicates through electric line 38 to solenoid 30 to operate on-off steam valve 40 to shut down or start up the unit. Also pressure switch 32 connected to steam line 3 through line 37(A) and to pneumatic gauging device 31 through line 37 can override signals from the pneumatic gauging device in case the steam pressure in line 3 exceeds pre-set limits. 

FIG. 4 is a cross sectional side view of another embodiment of the one port embodiment of this invention. Stuffer tube 2 has recessed port 60 which communicates to stuffer tube 2 through manifold 62 and orifices 63, 64 and 65. 

FIG. 6 is a cross sectional plan view having the same numbers corresponding to the same elements. 

FIGS. 5 and 7 are cross sectional side and plan views of recessed port 60 communicating through elongated port 61 to stuffer tube 2. 

Referring to the preferred embodiment in FIG. 8, the yarn plug, not shown, but as seen in FIGS. 1–3, in stuffer tube 2 is formed by impinging yarn on the plug from steam line 3. Details can be found in U. S. Patent No. 3,409,356. Steam flow is controlled by control valve 4. The end of the yarn plug is located, by controlling steam flow by means of this invention, between ports 72 and 74. Manifold 73 opens on one side with ports 72 and 74 and on the yarn plug side communicates with said stuffer tube through orifices 91 to 95 shown in detail FIGS. 9 and 10. Ports 72 and 74 are connected to air conduits 71 and 75 respectively. Conduit 71 for port 72 communicates with proportional pressure sensor controller 70 so that controller 70 senses variance in back pressure in manifold 73. Air under constant low pressure under 1 pound per square inch gauge, is supplied to manifold 73 through port 74 from line 75. Air for the entire pneumatic control system is supplied through conduit 76. Pressure regulator valve 81 controls pressure at about 18 psig in line 76. Pressure gauge 90 indicates pressure downstream of valve 81 in line 76. Filter 89 filters out any dirt in supply air pressure to valve 81. Shut off valve 87 can be used to stop air flow to the entire system. Pressure regulator valve 82 maintains a pressure of under 1 psig in conduit 75. Conduit 77 supplies high pressure air, 18
p.s.i.g. to pneumatic controller 70. Conduit 78 and pressure regulator valve 83 supply an adjustable bias signal of 3 to 8 p.s.i.g. to controller 70. As controller 70 senses variation in pressure in manifold 73 through conduit 71 it controls the opening or position of steam control valve 4 by sending proportional signals through line 79 and three way valve 80 to the diaphragm of the pneumatically controlled steam control valve 4. Three way valve 80 is necessary to keep steam control valve 4 open when the plug is absent in stuffer tube 2 to keep stuffer tube 2 hot and avoid delay to reheat after process down-time. This is accomplished by connecting three way valve 80, which is a solenoid, electrically by lines 85 to a motor on a driven roll, not shown, in the process. When the motor is not energized, three way valve 80 is switched to conduit 86 and away from controller output conduit 72. Pressure regulator valve 84 maintains constant pressure downstream in line 86 set to provide appropriate pressure on diaphragm of steam control valve 4 to keep it open enough to keep stuffer tube 2 hot. To shut down the steam line shut off valve 88 is used. The various plug-ins P are means supplied to permit plugging in of a pressure gauge assembly to measure pressure in lines 71, 75, 78 and 79.

Example

Conditions of Example 1 of U. S. Pat. No. 3,409,356 to Longbottom were followed with an improved steam jet and stuffer tube having the two port embodiment of this invention to control yarn plug location. The yarn plug was successfully controlled between ports. The ports were 0.32 inch apart longitudinally. The nearest port to the stuffer tube discharge end was three-eighths inch from end to center of port. The ports were supplied air at a gauge pressure of 20 inches of water.

We claim:

1. In a process for texturing yarn by directing heated fluid against a yarn plug in a stuffer tube and discharging said yarn, the improvement comprising controlling the location of the end of said yarn plug at the discharge end of said stuffer tube by sensing the plug end location with at least one jet of fluid issuing from a port near the discharge end of said stuffer tube, at least one of said ports communicating with a pressure sensor controller which actuates a control valve which controls flow of said heated fluid.

2. The process of claim 1 wherein the heated fluid is steam.

3. The process of claim 1 wherein the jet of fluid is an air jet.

4. Apparatus for controlling the location of a plug of textured yarn near the discharge end of a stuffer tube, said yarn being texturing by directing heated yarn in a current of heated fluid against said yarn plug in said stuffer tube and discharging said yarn comprising a stuffer tube having at least one port, said port issuing a jet of fluid, said port communicating with a pressure sensor controller, so that when the yarn plug is located to be impinged by said jet of fluid issuing from said port, the resulting back pressure can be sensed, means to transmit said output from said pressure sensor controller to actuate a flow control means in said heated fluid supply means, so that said yarn plug end is located adjacent said port in said stuffer tube by controlling flow of said heated fluid supply means responsive to back pressure of said fluid jet issuing from said port.

5. The apparatus of claim 4 wherein the port is elongated longitudinally.

6. The apparatus of claim 4 wherein there are between two and five longitudinally spaced ports located near the discharge end of said stuffer tube.

7. The apparatus of claim 6 wherein said ports are closely adjacent.

8. The apparatus of claim 4 wherein there are two ports located near the discharge end of said stuffer tube.

9. The apparatus of claim 8 wherein said port is located beyond the end of said stuffer tube.

10. The apparatus of claim 8 wherein the ports are recessed in said stuffer tube and communicate with said stuffer tube through a manifold having a series of orifices opening into said stuffer tube.

11. The apparatus of claim 10 wherein said controller is a fluidic amplifier.

12. The apparatus of claim 11 wherein said output of said controller is through a three-way valve connected to said texturing process so as to override said output with a constant signal to open said flow control means enough to keep said stuffer tube hot when said process is not operating.

13. The apparatus of claim 11 wherein said amplifier has fixed gain, adjustable, and rate controlled output relay.

14. The apparatus of claim 13 wherein said amplifier controller maintains a minimum opening of the fluid control valve at absence of plug in said stuffer tube.

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