Oct. 6, 1959 E. W. REID 2,907,450

TENSIONING MECHANISM FOR ENDLESS WEBS

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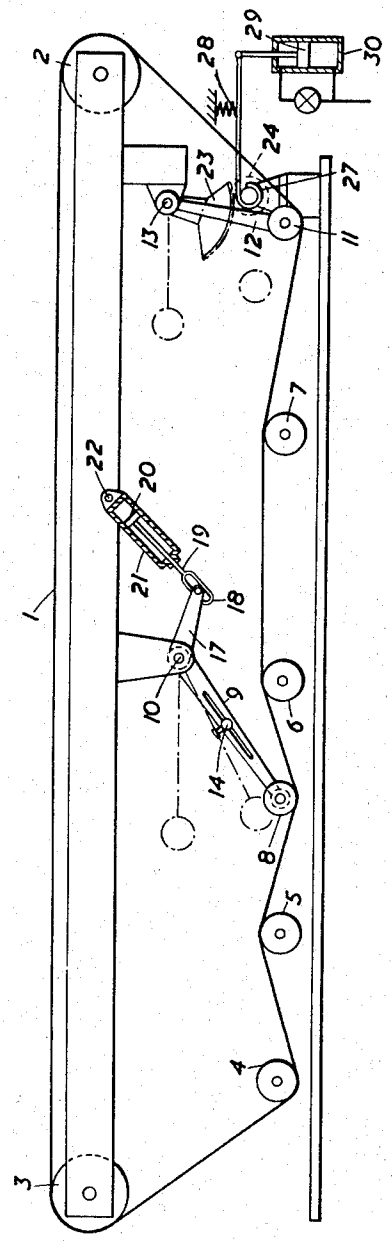

FIG. 1.

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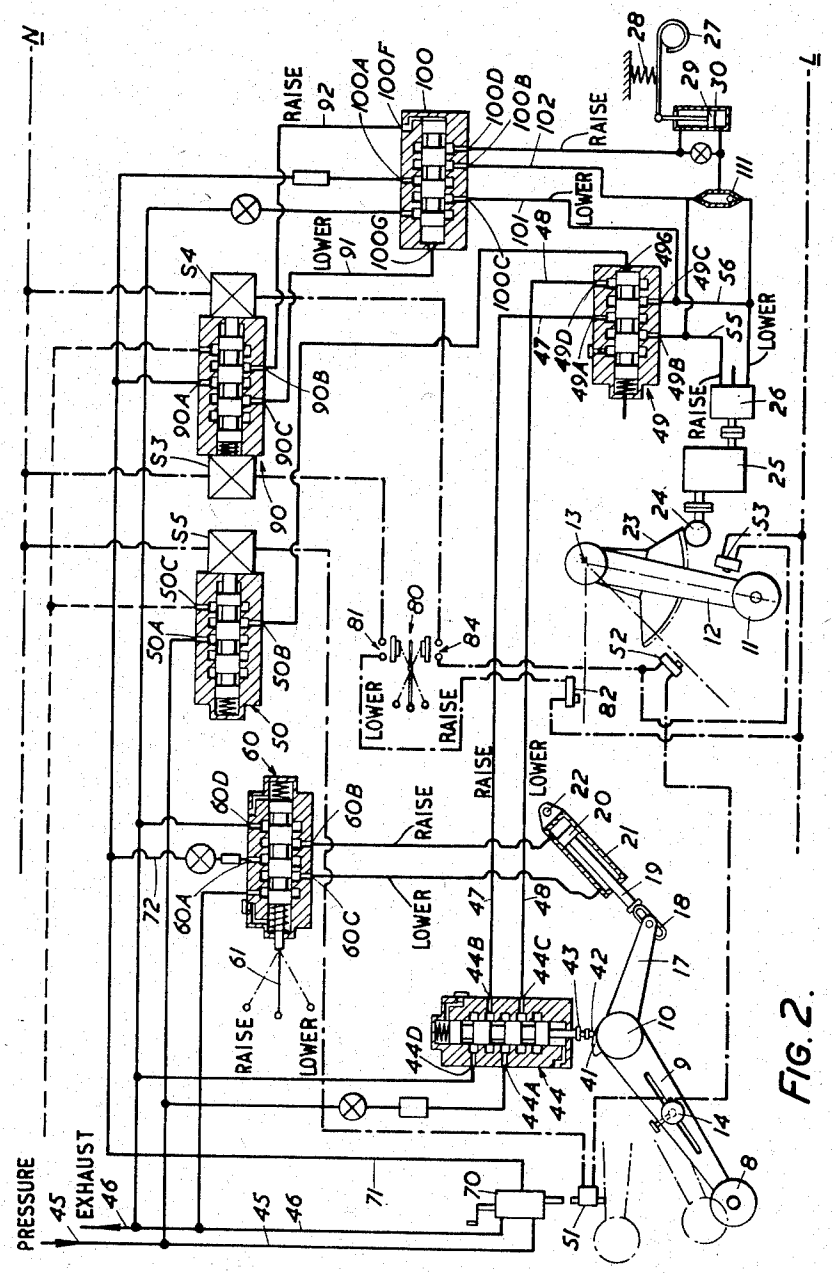

FIG. 2.

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TENSIONING MECHANISM FOR ENDLESS WEBS

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11 Claims. (Cl. 198—208)

This invention relates to tensioning mechanism for endless webs of the kind used to convey material and is particularly but not exclusively applicable to the wire webs used in paper-making machinery and onto which the pulp is discharged so that as the web travels this pulp is gradually dried and is removed as a strip at the delivery end of the wire.

The form of tensioning mechanism with which the invention is concerned is that in which a jockey pulley which may be spring-pressed, hydraulically pressed, or weight operated, acts on the return (i.e. the underneath) half of the wire to maintain the desired tension in the wire, while one another roller, over which the wire also travels is adjustable, to enable the jockey roller to be maintained as far as possible in an approximately predetermined position relative to the wire, as is necessary if it is to operate satisfactorily to maintain the required tension.

For convenience herein the roller which is adjustable to maintain the position of the jockey roller at approximately the desired position in spite of stretching of the wire will herein be referred to as the adjustable roller.

According to the invention tensioning mechanism for an endless web includes a jockey roller biassed onto the web to control its tension, an adjustable roller bearing on the web at another point, and control means by which movement of the jockey roller out of a predetermined position relative to the web due to changes in the length of the web causes automatic operation of relay mechanism to move the adjustable roller relative to the web in such a direction as to adjust the web in a manner to restore the jockey roller to its predetermined position.

Thus if due to stretching of the web the jockey roller moves beyond the predetermined point under the action of its spring, hydraulic device or other force acting on it, the relay mechanism is automatically brought into operation by such movement and the automatic adjustment of the adjustable roller which then takes place restores the jockey roller to its correct position, thus automatically terminating the operation of the relay mechanism.

In a convenient arrangement the adjusting mechanism may be hydraulically operated, as for example by means of a hydraulic motor, or ram and the adjustable roller is operated by a reversible hydraulic motor and the supply to the motor is under the control of a relay control valve under the direct control of the jockey roller. For example the support for the jockey roller may carry a cam which operates the relay control valve, which cam it will be understood is automatically moved so as to render the valve inoperative when as a result of the desired adjustment having been made the jockey roller has been restored to its correct position.

In one preferred arrangement according to the invention the jockey roller is carried on the end of a pivoted supporting arm. Preferably the jockey roller is biassed onto the web by a weight. Conveniently manual means is provided for raising both jockey and

adjustable rollers to remove the tension from the web. An overriding control may be provided for rendering the automatic relay mechanism inoperative when the manually operable means are in operation. The overriding control may comprise a cut-off valve between the reversible hydraulic motor and the relay control valve. The cut-off valve is preferably hydraulically operated by pressure derived from a solenoid-operated auto-control valve, means being included for raising the jockey and adjustable rollers hydraulically by pressure derived through a master valve, the solenoid of the solenoid-operated auto-control valve being in series with a cut-out switch, and the master valve being adapted when actuated to supply the raising means to operate the switch so as to cause the solenoid to actuate the auto-control valve and hence the cut-off valve to stop the hydraulic motor.

The invention may be carried into practice in various ways but one specific embodiment will now be described by way of example with reference to the accompanying drawings, in which

Figure 1 shows the general arrangement of a paper making machine wire web incorporating a jockey roller and adjustable roller in accordance with the invention, and

Figure 2 shows diagrammatically the electrical and hydraulic control and operating circuits.

In the construction shown in Figure 1 the wire **1**, has an upper run which is supported substantially flat and passes around two main rollers **2** and **3**. The underneath or return run of the wire passes under one fixed roller **4** and over three fixed rollers, **5**, **6** and **7** and is acted upon at a point between the rollers **5** and **6** by a jockey roller **8** carried on an arm **9** and pivoted at **10** to the frame of the machine, and is acted upon at a point between the rollers **2** and **7** by an adjustable roller **11** mounted upon an arm **12** pivoted to the frame at **13**.

As will be seen in both figures the arm **9** on which the jockey roller **8** is carried is formed integral with a further arm **17** which is connected to the slotted end **18** of a piston rod **19** carrying at its other end a double acting piston **20** within a hydraulic cylinder **21** pivoted to the frame about a pivot at **22**. The arm **9** carries an adjustable weight **14** by which the tension to be applied by the roller **8** can be set. During normal operation the end of the arm **17** can slide in the slotter end **18** of the piston rod **19**, but as will be described in detail later the arm **9** can be lifted clear of the wire to the upper of the dotted positions shown by downward movement of the piston **19**. The arm **12** carrying the adjustable roller **11** is provided with a quadrant **23** engaged by a pinion **24** which, through a gear box **25** can be rotated in either direction by a reversible hydraulic motor **26** as shown in Figure 2. As shown in Figure 1 a brake **27** is normally applied by a spring **28** to the shaft of the pinion **24** but is capable of being released by hydraulic pressure acting on one face of a piston **29** disposed within a cylinder **30** as diagrammatically shown in Figure 1. The brake is also shown in Figure 2 but has been displaced from the pinion shaft for clarity and ease of showing the circuits.

As shown in Figure 2 the arm **9** carrying the jockey roller **8** also carries a cam **41** arranged to act on a roller **42** on an adjustable tappet **43** which, in turn, is arranged to act upon the spring pressed piston of a hydraulic valve **44**, which is of well known type and is shown somewhat diagrammatically, as are other valves to be described shortly. It will be seen that the valve **44** has an inlet **44A**, two outlets **44B** and **44C** and an exhaust connection **44D**. The inlet **44A** is connected to a pressure line **45** whilst the exhaust connection **44D** is connected to an exhaust line **46**. For convenience where a valve connects one passage to another for the flow of

fluid under pressure, it will hereinafter be referred to as the passage of pressure across the valve.

The two outlets 44B and 44C are connected by means of lines 47 and 48 to inlets 49A and 49D respectively of a pressure operated motor-control valve 49. This valve is spring centred to a shut-off position, but is normally moved to the left by pressure applied to the inlet 49G, to place inlet 49A in communication with outlet 49B and inlet 49D in communication with outlet 49C. These two outlets 49B and 49C are connected, by lines 55 and 56 respectively, to the hydraulic motor 26.

The position of the adjustable roller is automatically governed by the position of the jockey roller 8 in the following way.

As the jockey roller 8 rises or falls it actuates the cam 41 to raise or lower the piston of the valve 44. Assuming, for example, that the wire of the paper making machine stretches, the jockey roller 8 will fall and hence the cam will be rotated to permit the piston of the valve 44 to be spring biassed downwards and place the inlet 44A of the valve in communication with the outlet 44C so that pressure passes across the valve 44 and along the line 48. It will be assumed that the valve 49 is pressure operated to the open position by pressure applied to the inlet 49G although the details of the manner in which this is effected will be described later.

Accordingly the pressure in the line 48 passes across the motor-control valve 49 to the outlet 49C and hence to the line 56 which is in communication with that side of the motor 26 which will cause it to drive the gear box and pinion in such a direction as to lower the adjustable roller 11 to take up the slack in the wire. Such take-up of the wire of course raises the jockey roller 8 to a datum position at which the valve 44 is closed and hence stops the motor.

If for some reason the jockey roller is raised during operation of the machine, for instance by shrinkage of the wire, to a position above the datum position the valve 44 will be moved to a position at which the inlet 44A and outlet 44B of the valve 44 are in communication causing the motor 26 to operate in the reverse direction by pressure applied through line 47 across the valve 49 and through the line 55. Hence the adjustable roller in this instance will be raised by the pinion 24 and quadrant 25 to slacken the wire until the jockey roller is restored to its datum position.

As has been mentioned the automatic operation of the apparatus is under the control of the motor-control valve 49 which is normally held open against its centering spring by pressure applied to its right hand end or inlet 49G. This pressure is derived from the outlet 50B of an auto-control valve 50 having its inlet 50A connected to the main pressure line 45. This valve is spring-centred to a closed position but normally held in an open position by a solenoid S5 in series with three normally closed limit switches 51, 52 and 53.

It will be seen that the limit switch 51 is placed above the arm 9 of the jockey roller 8 so that it will be opened if the arm should be raised to the almost horizontal position shown in dotted lines. The two limit switches 52 and 53 are placed at the desired upper and lower limits of movement of the arm 12 of the adjustable roller 11. Thus if any one of the three limit switches 51 to 53 should be opened by the appropriate roller arm the solenoid S5 will be open-circuited and the auto-control valve 50 returned to its central closed position. Such movement cuts off the control pressure to the inlet 49G of the motor control valve 49 which is accordingly centred by its spring to prevent further automatic operation of the motor 26.

WIRE CHANGING

(a) *Raising of jockey roller 8*

In the event of it being necessary to change the wire completely it will be appreciated that the jockey roller 8 has to be raised out of contact with the wire and this is done hydraulically by the piston rod 19.

Pressure for raising or lowering the roll 8 by the piston 19 is derived from a manually operated control valve 60 which connects either of its outlets 60C or 60B with its inlet 60A according to the position of its operating lever 61. Pressure to the inlet 60A is derived from a master control 70 via a pressure line 71 and sub-line 72.

It will be noticed that the master control 70 is so positioned as to open the limit switch 51 when it is operated to supply the control valve 60. Accordingly as soon as the control valve 60 is supplied with pressure, to permit operation of the piston 19 to raise the roll 8, the automatic control of the apparatus is stopped since the circuit to the solenoid S5 and hence the pressure to the valve 49 will be interrupted by opening of the limit switch 51.

Thus there is no possible danger that the raising of the piston 19 will result in automatic variation in position of the adjustable roll 11.

(b) *Raising of adjustable roller 11*

For wire changing it will also be necessary to raise the roller 11 to a position at which it is entirely clear of the wire and hence beyond the limit switch 52.

This is manually controlled by a two-way control switch 80 having one pair of contacts 81 in series with a solenoid 53 of a further control valve 90, and an upper limit switch 82.

The second pair of contacts 84 of the switch 80 are connected in series with a solenoid S4 at the other end of the valve 90, and the lower limit switch 53. Thus as the adjustable roller is raised or lowered (in a manner to be described shortly) the solenoids S3 and S4 can be energised by operation of the switch 80 so long as their respective limit switches 82 and 53 are closed. As soon as the roller arm 12 reaches its uppermost or lowest position the appropriate limit switch will be opened and so prevent further energisation of the associated solenoid.

The valve 90 has an inlet 90A connected to the pressure line 71 from the master valve 70, and hence, as soon as the valve 70 is operated, pressure will be supplied to the valve inlet 90A. Such pressure is communicated across the valve to one or other of the outlets 90B or 90C depending on which of the solenoids S3 or S4 is energised to draw the piston of the valve to the right or left.

The outlets 90B and 90C are connected respectively by lines 91 and 92 to the control ports 100G and 100F at opposite ends of a pressure operated valve 100. This valve has an inlet 100A also in communication with the pressure line 71 from the master control valve 70. Depending on which of the ports 100G and 100F are placed under pressure from the valve 90 the piston of the valve 100 will move to the left or right to place the inlet 100A in communication with either the outlet 100C or outlet 100B. In this way pressure will be transmitted to one or other of the lines 101 or 102 which are respectively in communication with the lines 55 and 56 to the motor 26.

Accordingly, assuming the switch 80 to be moved to the "Raise" position, the contacts 81 will be closed to energise the solenoid S3. This will draw the piston of the valve 90 to the left to place the outlet 90C of this valve in communication with the inlet 90A to supply pressure via the line 92 to the right hand end of the piston of the valve 100. This will accordingly be moved to the left to place the outlet 100B in connection with the inlet 100A so that pressure is transmitted via the lines 102 and 55 to operate the motor 26 to raise the adjustable roller 11. So long as the switch 80 is maintained in the "Raise" position the motor will continue to raise the roller 11 until its arm 12 engages the limit switch 82 to open-circuit the solenoid S3. As soon as this happens the valve 90 is centred to cut off the pressure from the valve 100 and accordingly the motor will be stopped.

To lower the adjustable roller again the switch **80** is moved to the "Lower" position to close the contacts **84**. This energises the solenoid S4 to move the valve **90** in the opposite direction so that pressure is applied to the left-hand end of the valve **100** so that its inlet **100**A and outlet **100**C are in communication and the pressure will be communicated via the lines **101** and **56** to operate the motor in the "Lower" direction. Assuming the switch **80** is maintained in the "Lower" position the roller arm is lowered until it engages and opens the limit switch **53** which open-circuits the solenoid S4 to stop this operation.

As will be seen in Figure 2 the diagrammatically shown brake is connected to the piston **19** of the cylinder **30** the lower end of which is connected to a two-way valve **111** the opposite ends of which are connected to the lines **55** and **56** running to the motor so that whenever pressure exists in one or other of these passages the pressure is applied to the lower side of the piston **19** to maintain the brake in an off position. When there is no pressure in either of the passages **55** and **56** however, the brake cylinder **30** is relieved and the brake applied by the spring **28**.

What I claim as my invention and desire to secure by Letters Patent is:

1. Tensioning mechanism for an endless web including a jockey roller biassed onto the web to control its tension, an adjustable roller bearing on the web at another point, control means by which movement of the jockey roller out of a predetermined position relative to the web due to changes in the length of the web causes automatic operation of relay mechanism to move the adjustable roller relative to the web in such a direction as to adjust the web in a manner to restore the jockey roller to its predetermined position and manually-operable means for raising both jockey and adjustable rollers to remove the tension from the web.

2. Tensioning mechanism as claimed in claim 1 in which the adjustable roller is operated by a reversible hydraulic motor and the supply to the motor is under the control of a relay control valve under the direct control of the jockey roller.

3. Tensioning mechanism as claimed in claim 2 including an overriding control for rendering the automatic relay mechanism inoperative when the manually operable means are in operation.

4. Tensioning mechanism as claimed in claim 3 in which the overriding control comprises a cut-off valve between the reversible hydraulic motor and the relay control valve.

5. Tensioning mechanism as claimed in claim 4 in which the cut-off valve is hydraulically operated by pressure derived from a solenoid-operated auto-control valve, means being included for raising the jockey and adjustable rollers hydraulically by pressure derived through a master valve, the solenoid of the solenoid-operated auto-control valve being in series with a cut-out switch, and the master valve being adapted when actuated to supply the raising means to operate the switch so as to cause the solenoid to actuate the auto-control valve and hence the cut-off valve to stop the hydraulic motor.

6. Tensioning mechanism as claimed in claim 2 including a directional control valve having two solenoids adapted to be energised alternately to operate the valve for actuating the hydraulic means in either a raising or lowering direction.

7. Tentionsing mechanism as claimed in claim 6 including a changeover switch having alternative pairs of contacts, one pair in series with one solenoid and the second pair in series with the other solenoid.

8. Tensioning mechanism as claimed in claim 7 including upper and lower limit switches in the solenoid circuits, the switches being adapted to open circuit their respective solenoids when the adjustable roller reaches predetermined upper or a predetermined lower position.

9. Tensioning mechanism as claimed in claim 1 in which the means for raising the jockey roller comprises a hydraulic piston.

10. Tensioning mechanism as claimed in claim 9 in which the hydraulic piston is under the control of a manually-operated jockey-roller-control-valve.

11. Tensioning mechanism as claimed in claim 2 including a brake which is automatically applied to maintain the adjustment of the adjustable roller when the hydraulic motor is out of operation but released when the hydraulic motor is in operation.

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