Dec. 24, 1957 R. C. PARKES 2,817,514

CONSTANT TENSION ROLL DRYER

Filed Jan. 27, 1954 2 Sheets-Sheet 1

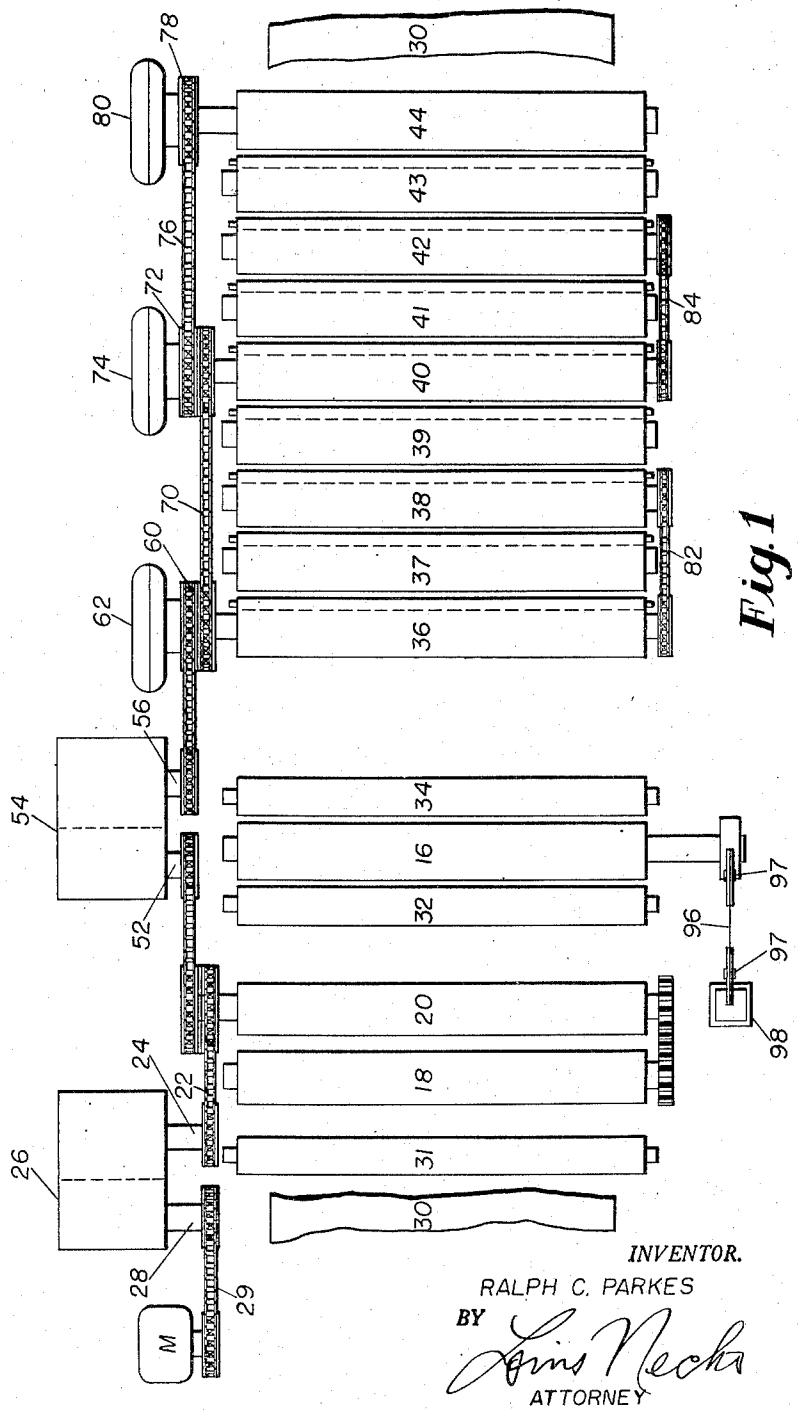


Fig. 1

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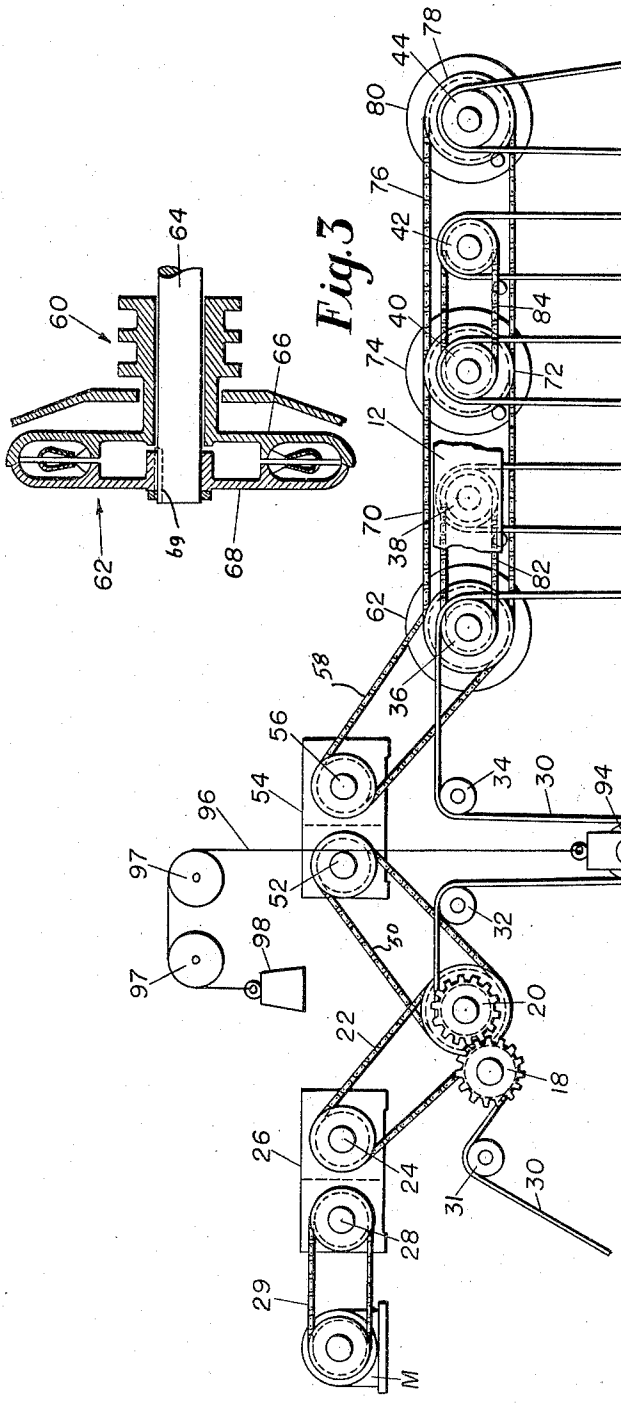


Fig. 3

Fig. 2

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United States Patent Office 2,817,514
Patented Dec. 24, 1957

2,817,514

CONSTANT TENSION ROLL DRYER

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Application January 27, 1954, Serial No. 406,444

6 Claims. (Cl. 271—2.3)

In drying cloth, or other sheet material, in a roll type dryer, the cloth is passed over an upper series of rolls and beneath a lower series of rolls so that the upper bights of the loops engage the upper surfaces of the upper rolls and the lower bights of the loops engage the lower surfaces of the lower rolls. A roll dryer of the type referred to also includes feed rolls, which are also referred to as metering rolls, for feeding the cloth into the drying chamber at the desired speed and some, or all, of the upper rolls are rotated about their axes in a direction to propel the cloth toward the delivery end of the drying chamber. The lower rolls are usually freely rotatable, idler rolls and will so be considered for the purpose of this application. However, as will hereinafter appear, the lower rolls may or may not, be driven, without in any way affecting the scope of the invention.

In cases where the cloth shrinks on drying, the shrinkage of the cloth, its weight, and the cumulative friction between the cloth and the rolls, will, unless controlled, produce an excessive tension on the cloth as it moves over the rolls in the drying chamber with corresponding adverse effects on the quality of the cloth. In cases where the cloth stretches on drying, the reverse is true and in the absence of proper control of its movement through the drying chamber, the cloth will, obviously, not have the desired texture or quality.

It is therefore the object of this invention to provide improved means for propelling the cloth through the drying chamber whereby the tension on the cloth will be maintained at the desired predetermined value, regardless of the nature of the cloth, regardless of whether it shrinks or stretches while drying and regardless of other attending circumstances.

A further object of the invention is to accomplish the foregoing object while at the same time, running the cloth through the dryer at optimum speed.

The full nature of the invention will be understood from the following specification and the accompanying drawings in which:

Fig. 1 is a fragmentary and diagrammatic top plan view of a roll dryer embodying my invention.

Fig. 2 is a side elevational view of the same.

Fig. 3 is sectional view of a hydraulic pulley or fluid which forms part of assembly shown in Figs. 1 and 2.

In as much as the present invention relates only to the means for controlling the tension on the cloth being dried, all details of the drying machine proper, such as the frame work, the housing, the heaters, the blowers, the ducts, the baffles etc., have been omitted and only the cloth feeding and the cloth propelling rolls and the means for rotating the rolls in such a manner as to maintain the tension to which the cloth is subjected at the desired value, are shown and described in sufficient detail to enable those skilled in the art to practice the invention.

As best shown in Fig. 2, the drying machine includes metering or feed rolls **18** and **20** which are geared together, or otherwise integrated, so that when roll **20** is driven it drives roll **18**. Roll **20** may be driven by means

of a sprocket chain **22** which is actuated by the power output shaft **24** of a Reeve variable speed control **26**, the power input shaft **28** of which is driven by a sprocket chain **29**. The sprocket chain **29** is driven by a reversible prime mover such as motor M. The Reeve variable speed control is now, and has for many years been, available on the market and its structure therefore not shown nor described. It is sufficient to say that it is reversible and that, even though the R. P. M. of the power input shaft **28** is kept constant, the R. P. M. of the power output shaft **24** can be varied through a relatively wide range. Thus, by varying the rate of rotation of power output shaft **24**, and hence of feed roll **20**, the rate at which the cloth **30** which is guided by idler roll **31** is fed onto the propelling rolls is also varied.

After leaving feed roll **20**, the cloth passes over an idler guide roll **32** and under a floating roll **33** which will hereinafter be further referred to. From roll **33** the cloth passes over an idler guide roll **34** and then over upper propelling rolls **36**, **38**, **40**, **42** and **44**, and under idler rolls **37**, **39**, **41** and **43**. From roll **44** the cloth is collected as at **46** or in any other suitable manner. It will be noted that rolls **18** and **20**, and rolls **36** to **44** are of the same diameter.

In order to propel the cloth through the drying chamber in a smooth condition and with a satisfactory degree of efficiency, some or all of the rolls **36** to **44** should be rotated at a rate which is equal to, or greater than, the rate of speed at which feed rolls **18** and **20** are rotated. This, together with the shrinkage of the cloth, and the cumulative friction between the cloth and the propelling rolls creates a tension which may reach an undesirably, or even dangerously, high value. Also, due to certain variable factors, the tension thus produced may not be uniform at various points between roll **36** and roll **44**.

In order to overcome these difficulties and to provide for accurate control and maintainance of the tension, I drive the feed rolls and the propelling rolls by means of fluid couplings or fluid power transmissions of the type shown in Patent No. 2,240,270 issued on April 29, 1941, to R. M. Schaeffer. In order to make reference to this, or to other patents unnecessary, I have shown the essentials of one such fluid coupling **62** in Fig. 3. From this figure it will be seen that pulley **60** and impeller **66** are loose on shaft **64** and that impeller **68** is keyed at **69** to shaft **64**. Therefore, if pulley **60** is rotated, impeller **66** will throw oil or other fluid, against impeller **68** to rotate shaft **64** and if shaft **64** is rotated impeller **68** will throw oil on impeller **66** and pulley **60** will be rotated.

A fluid coupling of the type shown in Fig. 3 is efficient enough when the power input shaft, be it pulley **60** or shaft **64**, is rotated at high speed and the efficiency of such couplings decreases as the rate of rotation of power input shaft is decreased. This is due to the fact that, at low speeds, the oil translated by the motor driven impeller can slip and will therefore transmit to the impeller to be driven only a fraction of its kinetic energy which, at low speed, is small to begin with. In other words, the power output shaft of a fluid coupling the power input shaft of which is rotated at low speed can be stopped by the application of little power even tho the power input shaft continues to rotate. This characteristic makes fluid couplings undesirable for operation at low or even at moderate speeds and all but useless for operation at low speeds.

According to my invention, I transform this inherent defect of a fluid coupling into an advantage and I make use of this inability of a fluid coupling to produce a large power output when its power input shaft is rotated at low speed to control the tension on a cloth being dried.

Reverting to the drawing, it will be seen that feed roll **20** is connected, by means of a sprocket chain **50**, with

the power input shaft 52 of a second Reeve variable speed control 54 and that the output shaft 56 of this control is operatively connected, by sprocket chain 58, to the power input pulley 60 of fluid coupling 62, above referred to. Pulley 60 of fluid coupling 62 is also connected, by means of a sprocket chain 70, to the power input pulley 72 of a second fluid coupling 74. Pulley 72 is, in turn, connected, by sprocket chain 76, to the power input pulley 78 of a third fluid coupling 80, which in this case, happens to be at the delivery end of the drying chamber. It will be understood that fluid couplings 74 and 80 are identical in structure and operation with fluid coupling 62 of Fig. 3. The power output shafts of fluid couplings 62, 74 and 80 are connected, respectively, to the shafts of rolls 36, 40 and 44. The intermediate rolls 38 and 42 may also be provided with fluid couplings but I have found it to be practical and less expensive, to drive roll 38 from roll 36 by a sprocket chain 82 engaging pulleys on the shafts of these rolls, and to drive roll 42 from roll 40 by a sprocket chain 84 engaging pulleys on the ends of the shafts of these rolls, as best shown in Fig. 1. By this arrangement, all of the upper, propelling rolls 36, 38, 40, 42 and 44 will be driven with the same force and, by varying the speed of rotation of output shaft 56 of variable speed control 54, the force driving the propelling rolls will be varied accordingly. To carry out my invention, I adjust the rotation of the power output shaft 56 of variable speed control 54 to such a rate that the power output shafts of fluid couplings 62, 74 and 80 will have a brake power of the desired value. This means that whenever the tension on the cloth is such as to exert a brake power on any of the propelling rolls greater than the said desired brake power value, such roll will stop turning even tho the power input pulley of the fluid coupling connected to said roll continues to turn at its initial speed. Stopping the rotation of a roll immediately lessens the tension at that point as well as the over-all or sum total of the tension exerted on the cloth. As soon as the tension falls below the desired value the roll resumes its rotation and brings the tension back to the desired value. Whether only one or all, of the rolls are thus momentarily stopped, the result, except in degree, is the same.

By way of example, let it be assumed that by rotating the feed rolls 18 and 20 at 150 R. P. M. (or any other rate) and by rotating the propelling rolls at 175 R. P. M. (or other rate) the cloth will be subjected to 1 foot pound tension which, for the purpose of this example is assumed to be the optimum tension. Let it further be assumed that the brake power of the power output shaft of each fluid coupling whose power input shaft is rotated at 175 R. P. M. will also be 1 foot pound. Now, as long as the desired conditions prevail all the propelling rolls 36, 38, 40, 42 and 44 will rotate at 175 R. P. M. and the cloth will be subjected to the desired tension. But, if for any reason, the tension on the cloth should exceed the 1 foot pound value in the vicinity of roll 38, for example, this roll will slow down, or will stop rotating, until the tension on the cloth at that point falls to, or below the 1 foot pound value. If the increase in tension is general, all the propelling rolls will stop, or will slow down, and since the independently driven feed rolls continue to feed cloth into drying chamber, the tension on the cloth is immediately relaxed. Conversely, if the cloth is slack the propelling rolls will rotate at their maximum speed. If this speed is not sufficient to take up the slack, the rate of rotation of the power input shafts of the fluid couplings is increased by increasing the R. P. M. of shaft 56.

It is thus clear that because the rotation of the power output shaft of a fluid coupling operating at low speed can be stopped without stopping the rotation of its power input shaft, I am able automatically and accurately to change the tension on the cloth within close limits so that the cloth will be subjected to uniform tension throughout.

It will be noted that the desired control is maintained by merely controlling the rate of rotation of shaft 56 or of shaft 24, or both, without the use of multiple, complicated and expensive electric or electronic devices or feed back systems which are difficult to install and difficult to maintain. In the drawings, only a small number of rolls is shown but in practice, a larger number of rolls is used. This makes the control of tension by conventional devices more difficult because it will involve the use of a detector in the vicinity of each propelling roll. By my invention, the rotation of each roll is automatically varied in response to the tension exerted by the cloth passing over said roll.

In order to provide for visual indication of the prevailing tension, I connect floating roll 33, which is carried by the cloth to one end of a suitably calibrated scale 90 the other end of which is anchored to a fixed support 92. The weight of roll 33 is balanced by a counter weight 98 carried by one end of a cord 96 which passes over rolls 97 and the other end of which is connected to the shaft of roll 33. As the tension on the cloth increases it exerts an upward pull on the scale 90 and by inspecting the scale, the operator can determine the value of the tension on the cloth. If the variations are small and momentarily they are considered as representing an acceptable minimum of "hunting." If the variations are large, or are of more than momentary duration, the operator increases or decreases the rate of rotation of shaft power output 56 of variable speed control 54 to increase or decrease the brake power of the propelling rolls as may be indicated, or by increasing or decreasing the speed of shaft 24 or of shaft 56 or both.

What I claim is:

1. Apparatus for moving sheet material over a number of supporting and propelling rolls and for automatically maintaining the tension under which it is desired to move the sheet material at a predetermined value, said apparatus including a feed mechanism for delivering the sheet material to one of said supporting and propelling rolls at a selected rate of speed, a fluid coupling associated with at least said one roll said coupling including a power input impeller, a power output impeller, and a casing enclosing said impellers and containing the coupling fluid, means connecting said output impeller to said one roll, and a variable speed drive including a power input shaft and a power output shaft, means operatively connecting said power input shaft to said feed mechanism whereby said power input shaft is driven at the same rate and with the same force as the feeding mechanism and means connecting said power output shaft to said power input impeller, for rotating said input impeller at a rate of speed calculated to impart a brake power to said output impeller and the roll driven thereby such that said roll will slow down as the tension exerted on it by the sheet material approaches said predetermined value and such that said roll will stop rotating when said tension reaches said value.

2. The structure recited in claim 1 and tension-responsive means for indicating the tension under which said sheet material is moving, said means including an idler roll between the feed mechanism and said one roll and over which the sheet material passes, yielding means for pressing said idler roll against said sheet material with a predetermined constant tension, and means for measuring any increase or decrease in said last mentioned tension.

3. The structure recited in claim 1 and a variable speed drive for actuating said feed mechanism.

4. The structure recited in claim 1 and a variable speed drive for actuating said feed mechanism, and means operatively connecting said feed mechanism to the variable speed drive which rotates said power input impeller.

5. The structure recited in claim 1 in which other fluid couplings are associated with others of said rolls, and in which said other couplings are operatively connected

to and are driven from the coupling associated with said one roll whereby said other rolls are driven with the same power and at the same speed as said one roll.

6. The structure recited in claim 1 in which the said sheet material is festooned over the rolls and forms pendant U-shaped loops suspended from said rolls, and idler rolls engaging the bottom bight portions of said loops to subject said loops to a predetermined constant tension.

References Cited in the file of this patent

UNITED STATES PATENTS

1,764,203	Garbutt et al.	June 17, 1930
2,016,083	Ensign et al.	Oct. 1, 1935
2,105,824	Simonds	Jan. 18, 1938
2,135,516	Hurxthal	Nov. 8, 1938
2,590,699	Heyer	Mar. 25, 1952