Dec. 27, 1960 A. LEIMER ET AL 2,966,593

METHOD AND APPARATUS FOR INSPECTING THE STRUCTURE OF FABRICS

Filed March 24, 1958 2 Sheets-Sheet 1

Fig. 1

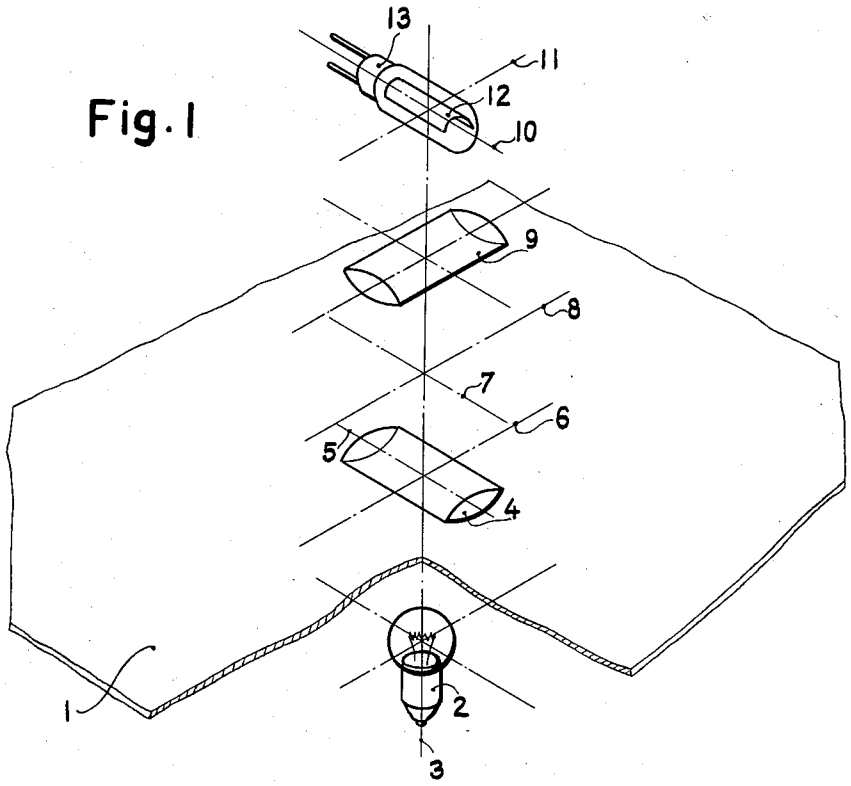
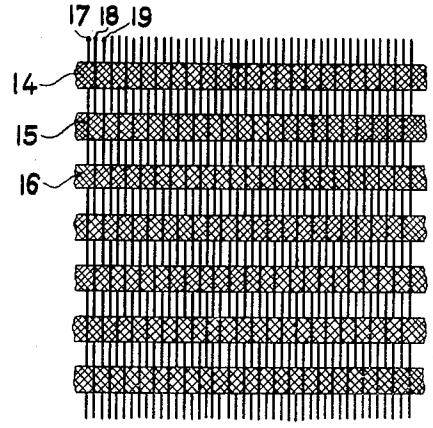


Fig. 2



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Fig.3

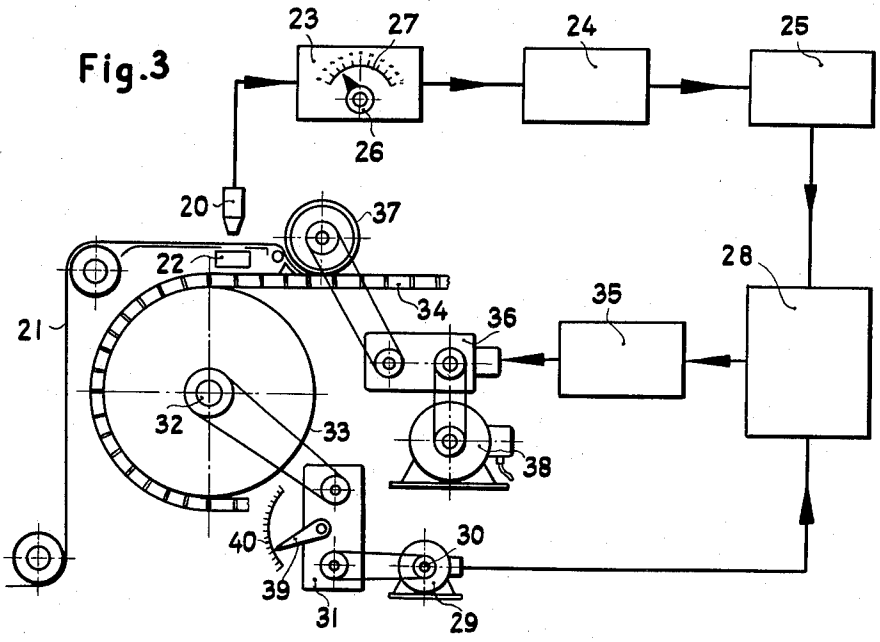
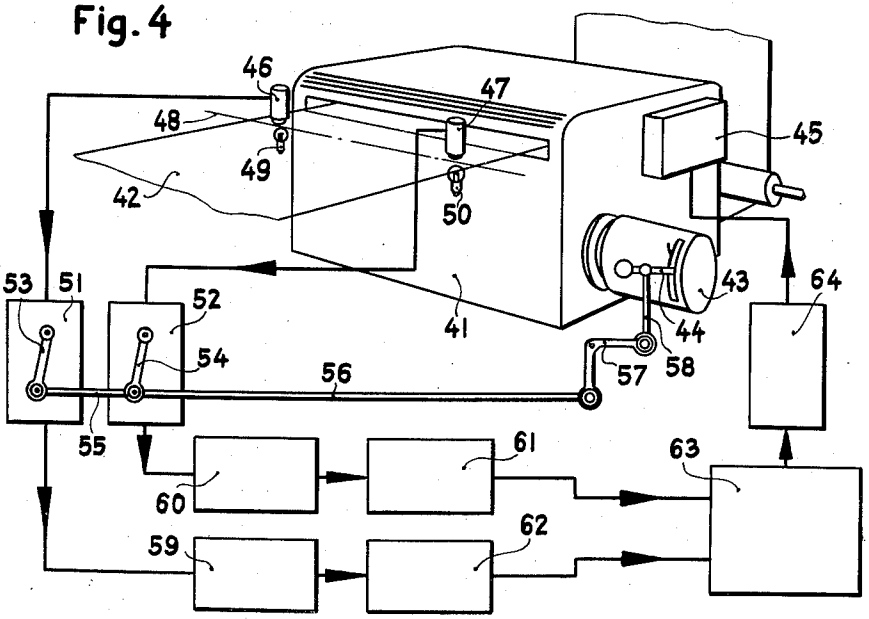


Fig.4



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METHOD AND APPARATUS FOR INSPECTING THE STRUCTURE OF FABRICS

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5 Claims. (Cl. 250—219)

This invention relates to a method and apparatus for the inspection of the structure of fabric with a view to controlling width adjustment or like apparatus.

In the production of textiles it is the general aim to finish fabrics in such a way that the made-up garment will not afterwards shrink when it is washed. To accomplish this purpose the fabric, in the course of the finishing procedures, is compressed by the amount of potential shrinkage in subsequent washing. One method of accomplishing this result consists in crimping the fabric by overfeed to the stenter. This process can be performed with the aid of relatively simple contrivances. Unfortunately the accuracy of contraction by the crimping method is very low. Compression of the fabric is effected by two so-called crimping wheels which overfeed a certain percentage in length of the fabric on to the pins of the stentering frame. The peripheral speed of the crimping wheels exceeds the speed of the stenter by the desired percentage.

However, extraneous factors, such as slippage of the fabric on the crimping wheels, variations in the tension of the fabric, and so forth, limit the accuracy of contraction to about ∓3 to 4% of the desired amount. The crimping wheels were hitherto driven either directly from the main drive shaft of the machine through an appropriate gearing or by means of an electrical transmission associated with the main drive of the machine.

The main object of this invention is to provide new and improved apparatus for the purposes mentioned above.

Another object of the present invention is to provide means for the automatic control of the speed of crimping wheels for the maintenance of the desired degree of compression of the finished fabric.

A further object of the invention is to provide means for facilitating the control of a weft straightening machine.

More especially, this invention is concerned with an apparatus for counting the picks of a woven fabric, particularly for the purpose of automatically controlling the feed rollers of stentering frames or for automatically controlling a weft straightening machine. According to one form of the invention one or several photo-sensitive detectors (which will be later described) accurately count the number of picks passing through definite control points. These control points are aligned in a direction at right angles to the direction of travel of the fabric. The number of picks is checked shortly before the fabric passes over the crimping wheels or into the weft straightening machine.

Each pick that passes under one of the photo-sensitive detectors gives rise to the generation of an electrical pulse. The pulses of each detector are passed through a frequency filter, an amplifier, and a clamp frequency generator for correcting the wave shape to a unit of a kind already known to the art which continuously forms the difference between the frequencies of the pulses deriving from two different sources. This electronic set

will hereinafter be referred to as the difference frequency generator.

The second pulse fed to the difference frequency generator derives from a reference source. For instance in a crimping wheel control system this may be a pulse generator controlled by the stentering frame. If different numbers of pulses reach the difference frequency generator, the latter will transmit a signal which depends upon the magnitude and sign of the difference. The amplified signal supplied by the difference frequency generator may be used in a crimping wheel control syster to vary the speed of the wheels in such a way that they will feed a predetermined number of picks per unit of length to the pins of the stenter. The pulse generator must therefore be operated by the main drive of the machine through a transmission ratio that will cause the generation of as many pulses as picks are required to be fed per centimetre travel of the stentering pins. This means that the pulse frequency of the pulse generator must be directly proportional to the speed of the stentering frame.

In order that the invention may be more readily understood the principles of a pick counting apparatus according to the invention will now be described, toge her with two applications thereof, with reference to the accompanying drawings in which:

Fig. 1 is a diagrammatic sketch illustrating the general lay-out of a detecting system for sensing (counting) the picks,

Fig. 2 represents the image of the fabric as it affects the photocell,

Fig. 3 is the general scheme of a lay-out according to the invention for the automatic control of a stenter feed, and

Fig. 4 is the general scheme of a lay-out according to the invention for the control of a weft straightener.

In Fig. 1 one side of a fabric 1, for instance the back of the fabric is illuminated by a lamp 2 arranged along the optic axis 3 of a lens system. The lens system comprises a cylindrical lens 4 (with longitudinal axis 5 and transverse axis 6) which produces an image of the fabric 1 in the plane of the axes 7 and 8. The axes 5, 6 and 7, 8 are relatively perpendicular. The optic axis contains their points of intersection, and penetrates the planes defined by the two pairs of axes 5, 6 and 7, 8 at an angle of 90°. The cylinder lens 4 produces an image of the fabric in the plane of the crossed axes 7, 8. This image produced by the cylinder lens 4 is a dimensionally distorted image of the fabric in the plane of the crossed axes 7, 8, the dimesnions of the fabric being considerably enlarged in the direction of axis 6 but reproduced to scale in the direction of axis 5. If the direction of the picks coincides with that of axis 5 the diameter of the picks will appear considerably enlarged in the image, whereas the warp threads in the fabric will appear in natural size. The original interlaced conformation of the weave of the fabric will therefore appear in the image in the form of a much coarser grid in which the picks are thick bars and the warp threads thin lines.

The effect of the arrangement can be even further improved if the image in the plane of the crossed axes 7, 8 is still further compressed in the direction of axis 7. This can be done by employing a second cylinder lens 9, which further reduces the thickness and spacing of the threads of the warp. This further image will then be projected into the plane of the two axes 10 and 11, which contain the photo-cathode 12 of the photocell (photo-electric cell) 13. The system of coordinate axes 10, 11 is located at a distance above the two systems of axes 5, 6 and 7, 8. The image of the fabric produced in the plane of the axes 10, 11 will therefore

appear approximately as shown in Fig. 2, that is, the picks 14, 15 and 16 will appear as thick bars, whereas the warp threads 17, 18 and 19 will be reduced to fine hair lines. The picks reproduced as thick bars will cause a variation in the intensity of the light at the photo-cell as they pass through the field of vision and they will will thus set up fluctuations in voltage in the electric circuit of the photo-electric cell. As the fabric travels across the detecting beam of light, each pick, insofar as it approximately coincides with axis 5, will therefore produce a pulse in the circuit of the photoelectric cell 13. These pulses may then be used for various control purposes in a manner that will be hereinafter described.

Fig. 3 shows a detector 20 for detecting the passage of the picks over the crimping wheel of a stentering frame. The fabric 21 is illuminated by a light source 22 below the photo-electric unit from underneath, that is to say by transmitted light. The alternating potentials arising in the photo-electric cell of the detector unit 20 are applied to a filter 23 which serves the following purpose. In the examination of different kinds of fabric it has been found that apart from the light fluctuations at the photo-cell due to the passage of the picks other interfering light fluctuations also occur which are produced by the varying density of the weft yarn or by patterns printed thereon. The potentials generated by these interference sources may swamp the potential alternations specifically due to the passage of the picks.

However, the frequency of the interfering potentials is always less than the pulse frequency caused by the travelling picks. If the feed speed of the fabric and the lowest number of picks that may be expected are known, then the lowest frequency of the required alternations can be readily calculated. It is therefore the object of filter 23 to prevent all those potential fluctuations which have a frequency that is less than the lowest possible frequency due to the passage of the picks, from reaching the following amplifier unit 24. The filter is therefore a high-pass filter with a cut-off frequency that can be adjustably controlled by manipulation of a rotatable knob 26. The cut-off frequency of the high-pass is now adjusted in conformity with the feed speed of the fabric. A scale 27 is therefore directly calibrated in terms of fabric feed speeds, say metres per minute. There would be no technological reason to prevent adjustment being automatic and controlled directly by the speed of the drive shaft of the machine.

The filtered voltage derived from the detector head 20 which now contains only the signals due to the passage of the picks are amplified in an amplifier 24 before they are applied to a wave form correcting clamp pulse generator 25. The clamp pulse generator 25 transforms the irregular wave form of varying amplitude of the pulses generated by the picks into pulses of even shape and height and these are then fed to the difference frequency generator 28. The difference frequency generator 28 is an electronic or electromechanical assembly of known construction which compares the different pulses applied to the same and generates a signal when a difference in the frequency of the incoming pulses arises, said signal representing the magnitude and the sign of the difference related to one of the incoming pulse trains as a reference base.

The second pulse train fed to the difference frequency generator 28 derives from a pulse generator 29 which supplies a definite number of pulses per revolution of its shaft 30. The pulse generator 29 is driven through an infinitely variable gearing 31 by the drive shaft 32 of the stentering wheel 33. This wheel 33 moves the stentering pins 34 through a definite distance per second and therefore causes the pulse generator to deliver a definite number of pulses per second. In other words, the pulse generator will, per unit distance of travel of the stentering frame, deliver a definite number of pulses. The transmission ratio between the shaft 32 of the stentering wheel 33 and the shaft 30 of the pulse generator 29 is so adjusted that the pulse generator 29 will generate that number of pulses per centimetre travel of the stentering frame which corresponds with the number of picks each centimetre of the finished and dried cloth is desired to contain. The transmission ratio can be adjusted by the manipulation of a lever 39 for controlling the gearing 31. Hence the adjustment can be made for the production of any desired number of picks per unit length of cloth.

Assuming that a difference arises in the pulse frequency of the pulse generator 29 (required pulse frequency) and the pulse frequency delivered by the clamp pulse generator 25 (actual pulse frequency) under the control of the detector head, then the difference frequency generator 28 will transmit a corresponding signal to an amplifying and control set 35 of known type and construction. By controlling the variable gearing 36 this control set can readjust the overfeed of the crimping wheel 37 within certain limits. The crimping wheel 37 is driven by a motor 38 which may constitute part of an electrical transmission system. When the difference frequency generator 28 generates a signal the crimping wheel will be accelerated or retarded and hence increase or reduce the overfeed of the fabric on to the pins of the stentering frame until the difference signal again disappears.

Fig. 4 shows a housing 41 which contains a device of known construction for straightening an obliquely inserted weft. The fabric or cloth 42 is advanced by means of a motor 43 of which the speed of rotation can be controlled by a lever 44. The control box 45 contains the terminals of the electrically controlled weft straightening machine. The two detector heads 46 and 47 observe the picks at the two selvedges 48 as they pass underneath. The fabric 42 is illuminated from below the detector heads 46 and 47 by the two lamps 49 and 50.

The signals emanating from the two detector heads 46 and 47 are fed through similar elements of a control system as those described in the previous example. The levers 53 and 54 for adjusting the cut-off frequencies of the high-pass filters are actuated by push rods 55, 56, a cranked lever 57, and lever 44 which serves for the adjustment of the speed of travel of the cloth.

The signal filtered by the high-passes 51 and 52 is fed through amplifiers 59, 60, clamp pulse generators 61 and 62 to the difference frequency generator 63. If the number of picks registered by the detector heads 46 and 47 differs, that is to say, if the picks in the cloth 42 tend to be displaced out of square to the warp, then the difference frequency generator 63 will generate a signal. This signal is delivered to the amplifying and control set 64 which causes the electrically controlled straightening machine to be adjusted accordingly.

The sign of the signal produced by the difference frequency generator 63 indicates in which of the two selvedges the picks are for instance more closely crowded together.

We claim:

1. A photo-electronic apparatus for automatically controlling stentering frames and weft straightening machines comprising photo-cell means arranged so as to be affected by light impulses caused by the picks in a moving fabric, and anamorphote optical system means for creating an image of the fabric distorted in at least one coordinate, said image being sensed by said photo-cell means, said anamorphote optical system means including cylinder lens means for producing a distorted image such that the width and the distance between consecutive picks is enlarged, whereas the width and the distance between adjacent warp threads is reproduced on a scale not greater

than natural size, said cylinder lens means including a pair of cylinder lenses.

2. Photo-electronic apparatus as claimed in claim 1, wherein said photo-cell means feeds a filter unit for the rejection of interference frequencies below the frequency generated by the travelling picks.

3. Photo-electronic apparatus as claimed in claim 2, characterized in that the cut-off frequency of said filter unit is adjustable and that its adjustment may be automatic as a function of the speed of travel of the fabric.

4. Photo-electronic apparatus as claimed in claim 3, characterized in that said apparatus is employed in conjunction with a stentering frame, said photo-cell means including a plurality of photo-cells, a plurality of crimping wheels, at least one photo-cell being associated preferably with each crimping wheel and the number of picks counted by each photo-cell being used for changing the speed of the associated crimping wheel.

5. A photo-electronic apparatus as claimed in claim 2,

said photo-cell means including a plurality of photo-cells, the pulses generated in each of said photo-cells being fed to a difference frequency generator, a crimping wheel, the difference frequency being used for changing the speed of said crimping wheel the reference pulse frequency being supplied by a stentering frame having a plurality of pins, depending upon the speed of the pins of said stentering frame.

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