

Jan. 25, 1938.

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2,106,612

STRAIGHTENER FOR WOVEN MATERIAL

Filed Aug. 6, 1935

2 Sheets-Sheet 1

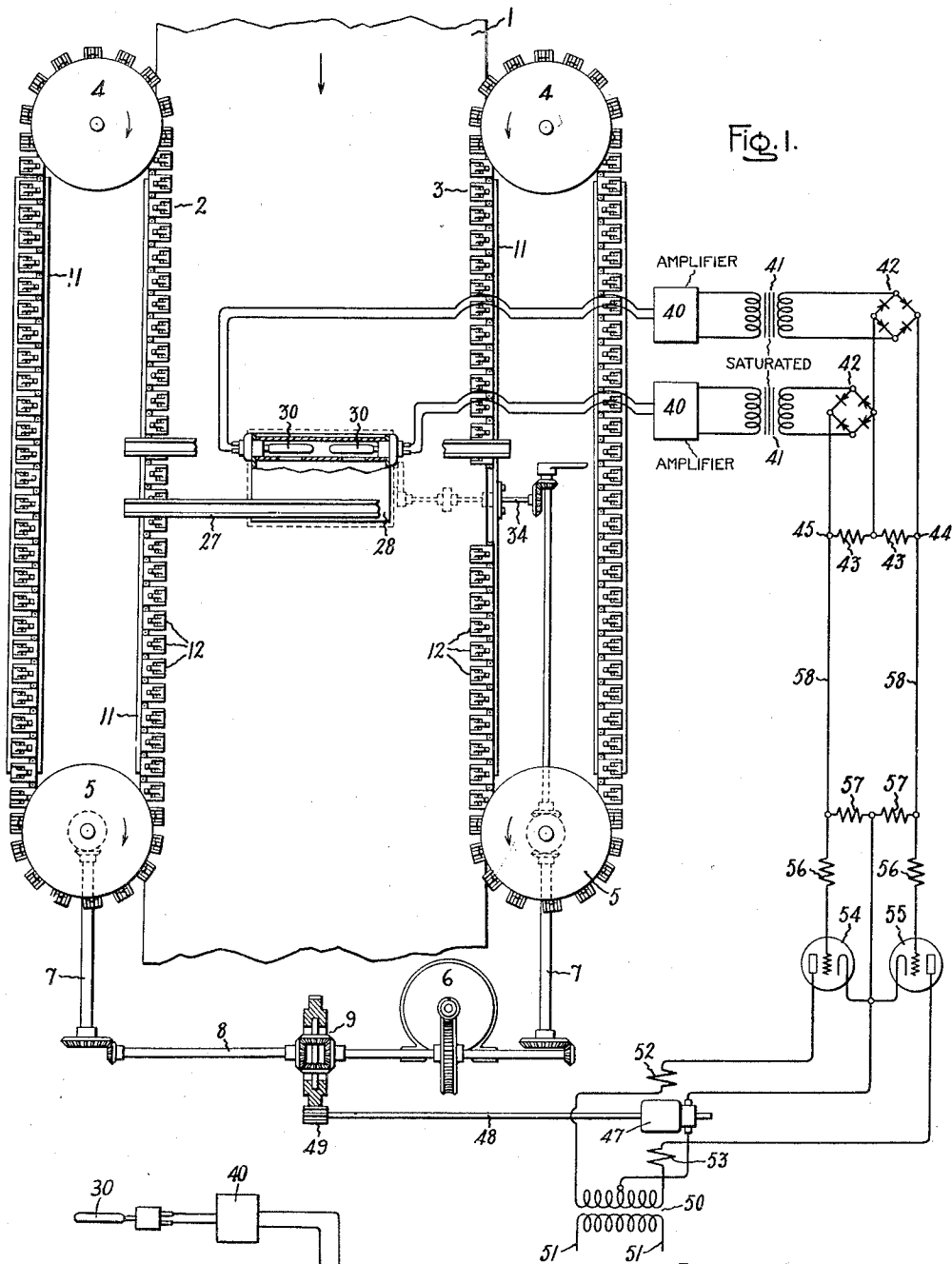


Fig. 1.

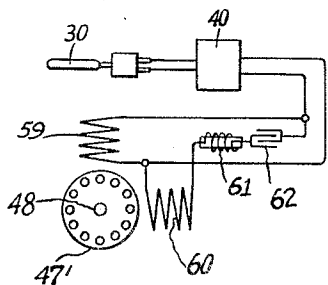


Fig. 6.

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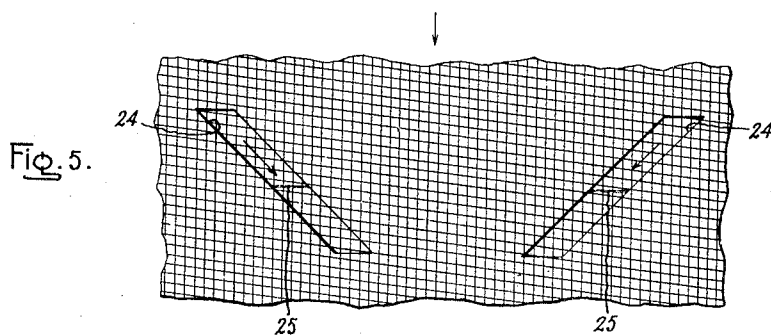
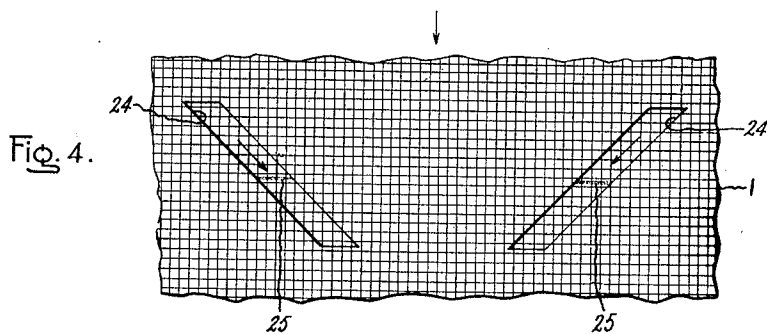
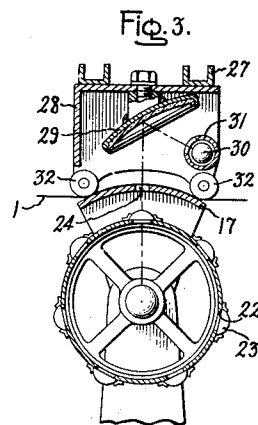
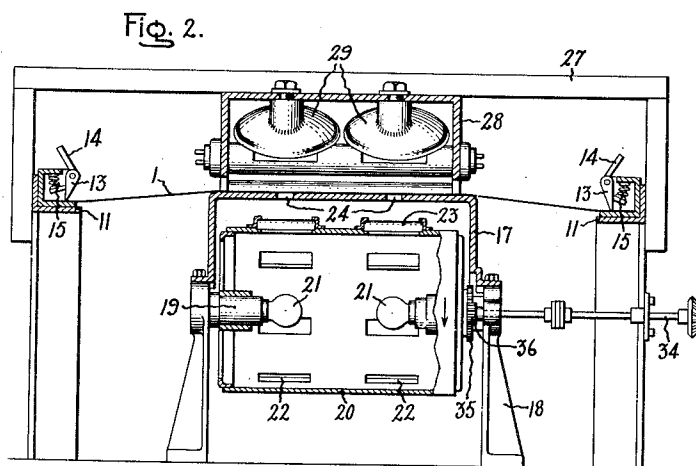
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UNITED STATES PATENT OFFICE

2,106,612

STRAIGHTENER FOR WOVEN MATERIAL

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Application August 6, 1935, Serial No. 34,932

12 Claims. (Cl. 26—52)

Our invention relates to apparatus employed in the manufacture of woven material and more particularly to that part of such apparatus by which the desired angular relation between the warp and weft elements of the finished material is maintained.

It is well known to those skilled in the art that woven material such for example as cloth often enters the tenter in a skewed condition, the warp and weft threads having other than the desired right angular relation to each other. Such a skewing of the material usually is objectionable particularly in the case of figured cloths and cloths which are customarily divided transversely by tearing rather than by cutting. To avoid excessive skewing some tenters in the past have been provided with manually controlled means by which the material when it was observed to be skewed could be straightened. Such means, however, being dependent upon the alertness and skill of an operator has not proved satisfactory. Moreover even to a skilled observer a certain amount of skew must occur before it will be observed and in many cases even a small amount of skew is objectionable.

One object of our invention is to provide apparatus which will automatically respond to a very small amount of skew in the material. Another object is to provide apparatus which in response to a skewing of the material will automatically effect a straightening thereof thereby removing the skew.

Our invention will be better understood from the following description taken in connection with the accompanying drawings, and its scope will be pointed out in the appended claims.

Referring to the drawings, Fig. 1 is a combined plan view of an embodiment of our invention, with parts broken away, and a circuit diagram; Fig. 2 is an enlarged detail view of a portion of the apparatus shown in Fig. 1; Fig. 3 is an end view of Fig. 2; and Figs. 4 and 5 are detail views drawn at a still larger scale showing portions of the woven material and the light slits.

Referring first to Fig. 1, we have represented at 1 a length of woven material, such for example as cloth, as it proceeds in the direction of the arrow from the entering end of the tenter. At 2 and 3 we have shown the tenter chains which are employed in connection with looms for weaving cloth to stretch the cloth laterally. The tenter is represented as comprising the two endless chains 2 and 3 each of which passes over the end pulleys 4 and 5, the latter being suitably driven by the electric motor 6 through the shafts

7 and 8 and appropriate gearing to produce the proper speed of the chains. The shaft 8 is divided intermediate its ends and a differential connection 9 inserted therein the purpose of which will be described later. Inasmuch as the purpose of the tenter is to stretch the material laterally, the two chains are slightly inclined to each other in the well known manner. Those portions of the chains of the tenter between the supporting wheels 4 and 5 are suitably supported by the guides 11. Each chain as shown comprises a plurality of elements 12 on each of which is the pivotally mounted dog 13 having the tail 14. Each dog normally is moved by the small coil spring 15 to a position clamping the woven material 1 against the adjacent portion of the chain element. Pulleys 4 and 5 have portions which engage the tails 14 to move the dogs to their release position against the springs 15. Thus as each element 12 leaves the wheel 4 the dog pivoted thereto engages the material and as each element reaches wheel 5 the dog thereof is caused to release the material.

Arranged beneath the material and intermediate the edges thereof is the skid 17 over which the material passes and which is slightly higher than the edge portions thereof engaged by the tenter. The skid 17 is shown supported by the pillar blocks 18 which also support the short stub shafts 19 which form bearings for the rotatable drum 20. Each stub shaft 19 also supports a small incandescent lamp 21, which lamps constitute a light source. The rotatable drum 20 is provided with two series of light openings 22 opposite of each of which is secured the small cylindrical lens 23 by which the light beam passing through each opening 22 is drawn down to a very narrow beam at the point where it passes through the material 1. The skid 17 is provided with two light slits 24 opposite the openings 22 through which the light beams reach the material 1. Each slit 24 is arranged at an angle, for example, at an angle of 45 degrees, to the warp elements of the material, the two slits being inclined in opposite senses, as clearly shown in Fig. 4. In this figure we have represented the material 1 for the purpose of illustration as being of a very coarse weave, and have represented the light beams drawn down by the cylindrical lenses as the stippled band 25. This band should have a length which will span several warp elements or threads of the material and will have a thickness, preferably for the best efficiency of the apparatus, approximately equal to the thickness of each weft element or

thread. It will be seen from the above description that as the drum rotates whether the material is moving or is stationary the narrow band of light 25 travels over the material in an oblique direction throughout the length of the light slit 24, the band being intercepted by the successive weft elements or threads of the material.

Supported above the woven material 1 by the framework 27 is the housing 28 containing the two concave mirrors 29 and the two photoelectric tubes 30 arranged in a suitable housing 31. Each mirror is arranged to reflect light received from one lamp 21 through one light slit 24 to one of the photoelectric tubes. The housing 28 is provided with the two rollers 32 by which the woven material is held against the skid 17. The drum 20 is rotated from the shaft 34, the drum and the shaft being provided respectively with the gear 35 and the pinion 36.

With the above described apparatus it will be seen that if the woven material is straight, that is, if it has no skew, as illustrated by Fig. 4, the frequency of the impulses received from one photoelectric tube will be equal to that received from the other, for it will be evident that each light band 25 in moving from one end of a light slit to the other will be intercepted by the same number of weft elements of the material. Should the material, however, become skewed, as represented for example by Fig. 5, then the number of interceptions of one beam will be increased while the interceptions of the other beam will be decreased. More particularly, referring to Fig. 5, light band 25 at the right of the figure will now be intercepted by a greater number of weft elements than before, while light band 25 at the left of the figure will be intercepted by a less number of weft elements. Hence the frequency of the impulses from the phototube actuated by band 25 at the right of the figure will be higher than the frequency from the phototube actuated by band 25 at the left of the figure. It is to be noted that in Fig. 5 the amount of skew of the material is greatly exaggerated over what would actually occur in practice, this exaggerated showing being purposely made to facilitate a clear understanding of the invention.

The above-mentioned change in frequency of the impulses received from the photoelectric tubes is made use of to give a response to the presence of a condition of skew and to effect a straightening of the material to remove the skew. Although various forms of apparatus may be employed to effect these results in response to a change in frequency of output of one or both of the photoelectric tubes, we shall now describe a preferred form of such apparatus. Each photoelectric tube 30 is connected to a suitable amplifier 40 and the output circuit of each amplifier connects with the primary winding of a saturated core transformer 41. By the latter means variations in frequency are converted into variations in energy output in the well known manner. The current from each transformer 41 is rectified for example, by the full wave rectifier 42 and each rectifier is connected to supply current to a resistor 43 the resistors having a common intermediate point which is connected to a common intermediate point of the rectifiers. The rectifiers are arranged reversely with respect to each other whereby the currents therefrom pass through the resistors 43 in opposite directions. Thus, if the frequencies from the two phototubes are equal, the amounts of energy delivered by the two transformers are equal and the points 44 and 45 of the

resistors will be at the same potential. Should the woven material become skewed in one direction the frequency of pulsation from one phototube will increase while that from the other will decrease and these changes in frequency will cause the potential at the point 44 to become greater or less than the potential at the point 45, depending upon the direction of the skew.

In order to straighten the material having the skew we employ the reversible electric motor 47 which connects through the shaft 48 with the pinion 49 engaging the ring gear of the differential 9. Motor 47 is connected to be driven through the transformer 50 connected to a source of alternating current supply 51, which for example, may be a 60 cycle, 110 volt commercial source. The motor is provided with two similar field windings 52 and 53 of which the inner end of one and the outer end of the other connect with the opposite ends of the transformer secondary. The flow of current through these windings and hence the direction of rotation of the motor is controlled by the two electron discharge valves 54 and 55, the anodes of which devices connect with the other ends of the field windings and the cathodes of which connect through the armature circuit with the midpoint of the secondary of the transformer. The grids of the two valves 54 and 55 connect through the limiting resistors 56 with resistors 57 which connect through the leads 58 with the points 44 and 45. A common intermediate point of these resistors connect with the cathodes of the valves.

It is thought that the operation of the apparatus will be clearly understood from the above description. As long as there is no skew in the material being woven, the number of weft elements which intercept the two light bands 25 as each band travels the length of its light slit 24 will be equal. Hence the frequencies applied to the saturated core transformers will be equal and the energy output of those transformers will be equal. Equal potentials therefore will exist at points 44 and 45 and valves 54 and 55 will pass equal currents to the opposing field windings of motor 47; hence this motor will remain stationary and the two endless chains of the tenter will travel with equal speeds.

Should the material become skewed in one direction the frequency applied to one transformer 41 will increase while that applied to the other will decrease. Unequal potentials will then be applied to the points 44 and 45. The valves 54 and 55 will pass unequal currents causing the motor 47 to turn in a direction such that the differential 9 will cause a difference in the amount of movement of the belts 2 and 3, the difference in movement being such as to straighten the material and remove the skew. The skew having been removed, the motor will remain at rest until a skew again develops.

While we have shown and described the apparatus as comprising duplicate light slits, phototubes, transformers and rectifiers, it will be understood that we may under certain circumstances find it desirable to employ but one photoelectric tube and cause it to control the direction of rotation of the motor shaft. For this purpose we may use apparatus of the form disclosed by the Steinmetz Patent 649,006. In Fig. 6 we have shown such an arrangement where the photoelectric tube 30 through the amplifier 40 supplies current of a certain normal frequency when there is no skew to the motor 47. The motor armature is mounted on the shaft 48 and as described in

the Steinmetz patent is energized by the two field coils 59 and 60 arranged 90° apart and connected to be supplied from the amplifier 40. In series with the coil 60 is the reactor 61 and the capacitor 62 whose reactances are equal at normal frequency at which time the motor armature remains stationary. If however the frequency increases to a value greater than the normal value the motor armature will turn in one direction and likewise if the frequency decreases to a value less than the normal value the armature will turn in the opposite direction. We may, moreover, merely employ some well known frequency responsive device, such as a frequency meter in circuit with one or both phototubes. With straightening apparatus adapted for manual operation, such as mentioned above, the operator would then watch the indicator for evidence of skew.

In the drawings we have chosen to show the drive connections of the drum so arranged that the light bands move in the same general direction as the material; that is, that component of their movement which is longitudinal of the material is in the same direction as the movement of the material. This, however, is not essential as each band if desired, may move in the opposite direction. Where the material moves at a speed such that movement of the bands and the material in opposite directions would produce a relatively high frequency, we prefer to cause the bands to move in the same general direction as the material, as illustrated, so that the output frequency of the phototubes will be a function of the difference of the material and band speeds. Obviously if the speed of the material and bands are equal there would be no interception of the light by the weft elements of the material and no frequency would be produced. We have obtained good results with apparatus in which the difference of speeds produced a frequency of the order of 50 to 200 cycles per second.

We have chosen the particular embodiment described above as illustrative of our invention and it will be apparent that various modifications may be made without departing from the spirit and scope of our invention which modifications we aim to cover by the appended claims.

What we claim as new and desire to secure by Letters Patent of the United States is:

1. In apparatus of the character described, the combination of means for supporting material having warp and weft members normally at right angles to each other, a source of light arranged to illuminate a portion of said material, a plurality of photoelectric devices arranged each to receive a beam of light from said source controlled by one of said members, means for moving said beams over said material in opposed oblique directions to said warp members and a device responsive to a difference in frequency of impulses from said devices.

2. An automatic straightener for woven material comprising a source of light arranged to illuminate portions of said material, a plurality of photoelectric devices arranged each to receive a separate narrow beam of light from said source interrupted by the weft members of said material, means for moving said beams across said material in paths inclined to each other and making substantially equal angles with the warp members of said material, means for straightening said material and means responsive to the difference in frequency of the impulses from said devices for controlling said straightening means.

3. An automatic straightener for woven material comprising a light source, means for directing a narrow beam therefrom on said material, means for moving said beam in a path inclined to the warp elements of the material, a photoelectric device arranged to receive said beam interrupted by the weft elements of the material, means for moving one edge of said material relative to the other and frequency responsive means connected with said photoelectric device for controlling said moving means.

4. An automatic straightener for moving woven material comprising a light source, means for directing a plurality of narrow beams of light therefrom on said material, means for moving each of said beams in a path inclined at the same angle with reference to the warp elements of said material, the inclination of the path of one beam being opposite to that of the other, a photoelectric device arranged to receive each beam interrupted by the weft elements of the material, means for advancing one edge of said material relative to the other and means responsive to the difference in frequency of the output of said devices for controlling said advancing means.

5. In apparatus of the character described, means for supporting woven material having warp and weft members, means for moving a plurality of narrow light beams each for a predetermined distance over said material in paths inclined in opposite directions to one of said members and means operative in response to the difference in the number of interceptions of said beams by the other of said members to indicate skew in said material.

6. In apparatus of the character described, means for supporting woven material having warp and weft members, means for directing a plurality of narrow light beams on said material, said beams extending substantially at right angles to said warp members, means for moving said beams in paths oppositely inclined to said warp members whereby the beams are intercepted by said weft members, photoelectric devices arranged to receive the unintercepted light of said beams and electro-responsive means operative in accordance with the difference in frequency of the output of said photoelectric devices to indicate skew in said material.

7. In combination, a plurality of members arranged to engage the opposite sides of a strip of woven material having warp and weft members, means for moving a plurality of light beams in paths inclined in opposite directions to said warp members and means responsive to a difference in frequency of interception of said beams by said weft members for producing relative movement of said strip engaging members.

8. An automatic straightener for moving woven material comprising a member over which the material is drawn having a plurality of light slits therein inclined in opposite direction to the warp elements of the material, a rotatable drum below said member, light sources therein, said drum having a series of openings arranged to cooperate with each of said slits, optical means at said opening for focusing the light through said slits on said material to form narrow bands thereon at right angles to said warp elements, a photoelectric device arranged to receive the light of each band controlled by the passage of the weft elements of the material, a tenter chain arranged to engage the material at each side thereof, means for driving said chains and means controlled by

the difference in output frequency of said photoelectric devices for varying the relative speed of said tenter chains.

9. In combination, means for engaging the edges of woven material having warp and weft members to move the same, means associated therewith for directing light on said material, a plurality of photoelectric devices arranged to receive light from the material, means for limiting the light received by each device from the material to a narrow beam moving in a direction inclined to one of said members, the inclination of the direction of movement of one beam being opposite to that of another beam and means responsive to the difference in output frequency of said photoelectric devices whereby the relative movements of said edges may be varied.

10. In combination, means for engaging the edges of a strip of woven material having warp and weft members to move the same, means associated therewith for directing light on said material, a plurality of photoelectric devices arranged to receive light from the material, means for limiting the light received by each device from the material to a narrow beam moving in a path inclined to one of said members, the path of movement of one beam being displaced laterally of said strip from that of another beam and means responsive to the difference in output frequency of said photoelectric devices whereby the relative movements of said edges may be varied.

11. In combination, means for supporting a strip of woven material having warp and weft members, a plurality of photoelectric devices, means for directing separate beams of light through said material into said devices, means for causing said beams to move relatively to said material in directions oppositely inclined to the edges of said strip whereby the beams are intercepted by said weft members, means including a reversible motor for advancing or retarding one edge of the strip relative to the other and means responsive to a difference in output frequency of said devices for controlling the direction of rotation of said motor.

12. In combination, tenter chains for engaging opposite edges of a strip of woven material having warp and weft members, a plurality of photoelectric devices, means for directing separate beams of light through said material into said devices, means for causing the beams to move relatively to said material in directions oppositely inclined to the edges of said strip whereby the beams are intercepted by said weft members, means for driving said tenter chains, a differential gear for varying the relative speeds thereof, a reversible motor connected to control said gear and means responsive to a difference in output frequency of said photoelectric devices for controlling the direction of rotation of said motor.

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