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Frederick et al.

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[54] **TENSIONLESS CLOTH FEEDING APPARATUS FOR CLOTH SPREADING MACHINE**

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[52] **U.S. Cl.**..... **242/67.2,** 242/67.3, 242/57.1, 242/68.7, 242/75.52, 226/16, 226/42

[51] **Int. Cl.**..... **B65h 17/02**

[58] **Field of Search**..... 226/16, 20, 42; 242/62, 75.52, 75.5, 75.51, 67.2, 67.3, 68.7, 57.1

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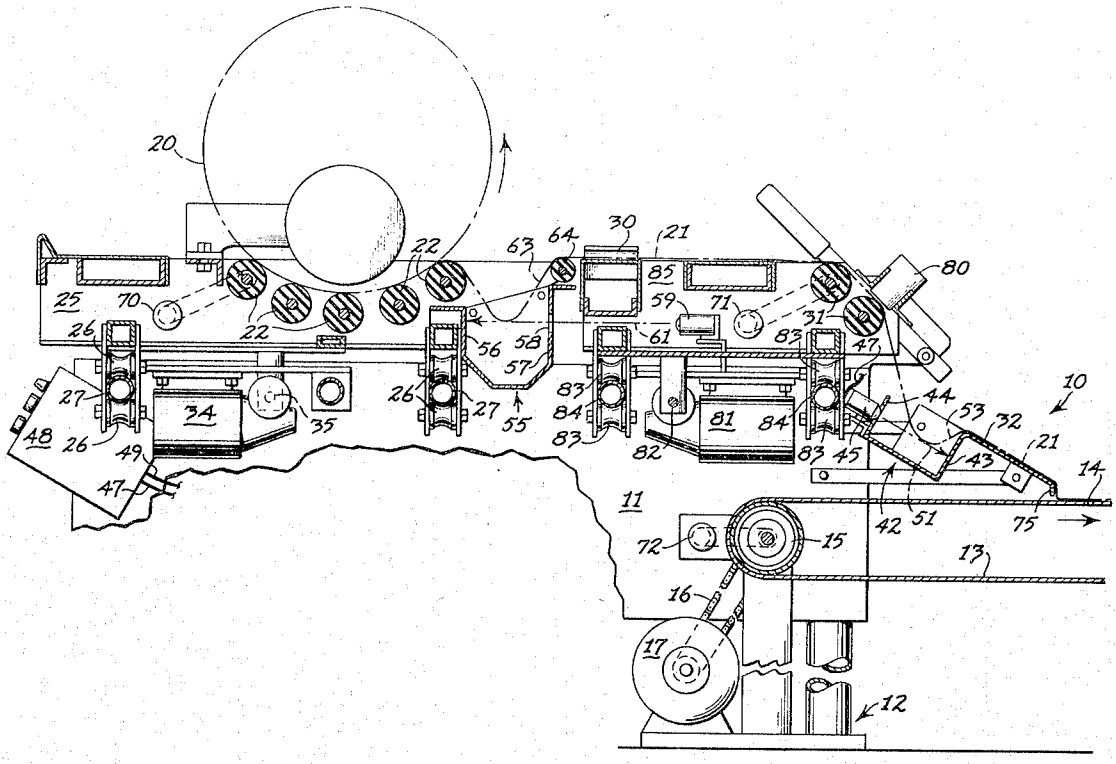
[57] **ABSTRACT**

In a stationary cloth spreading machine adapted to spread cloth upon a laying surface movable away from the spreading machine, cloth feed control apparatus including radiant energy sensing means for sensing excessive tension in the cloth, without frictionally engaging the cloth, to produce a relatively tensionless cloth feed.

12 Claims, 6 Drawing Figures



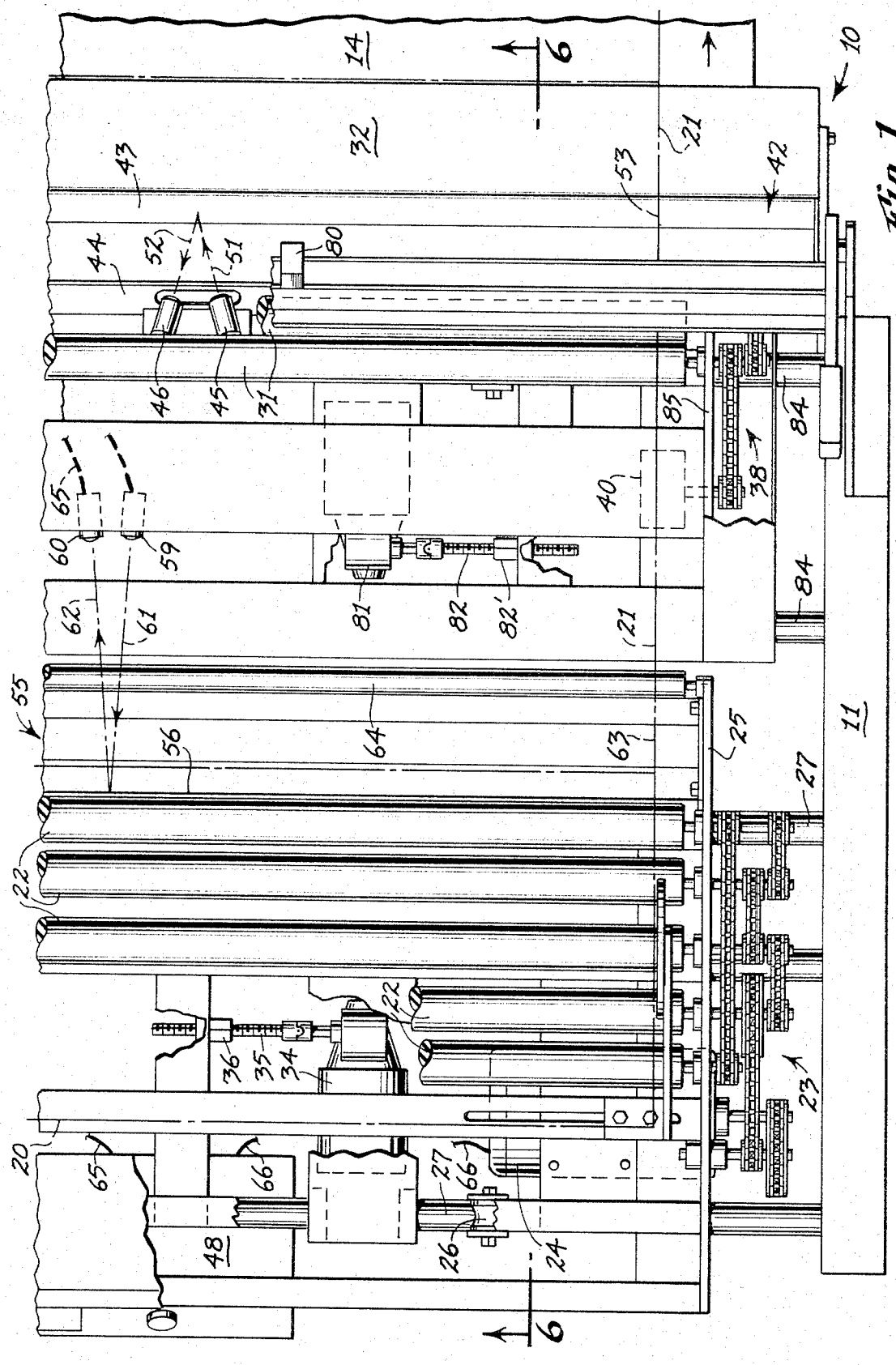

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Fig. 1

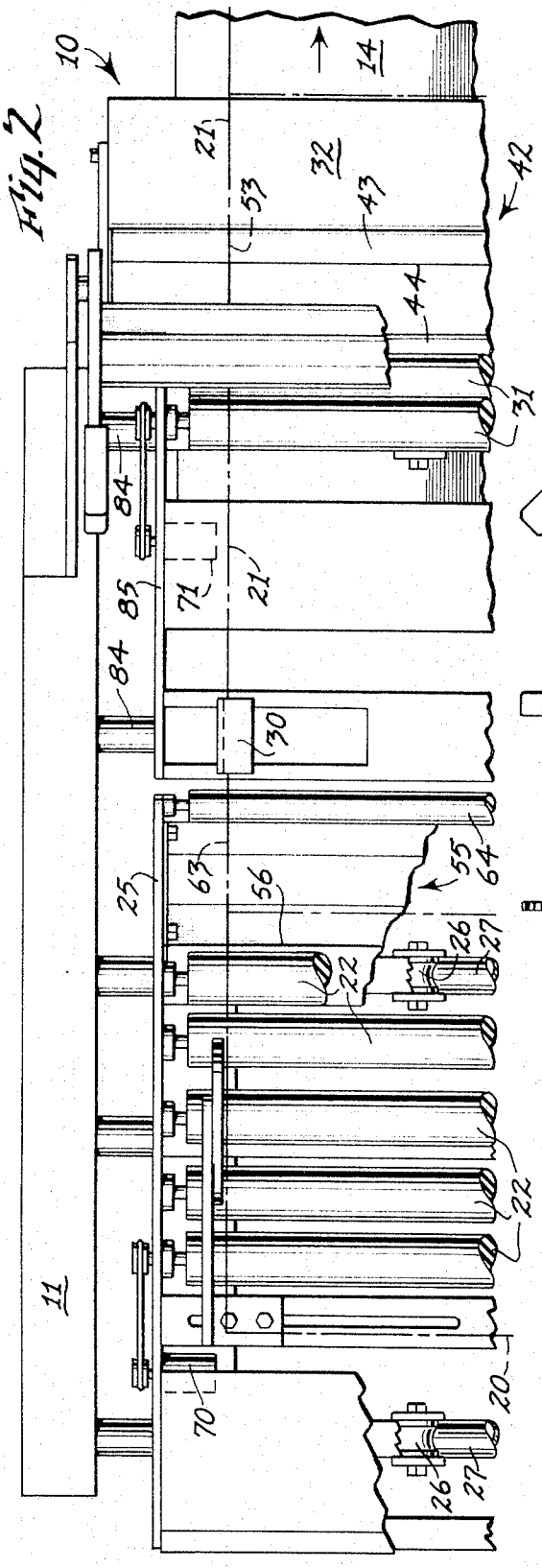

Fig. 2

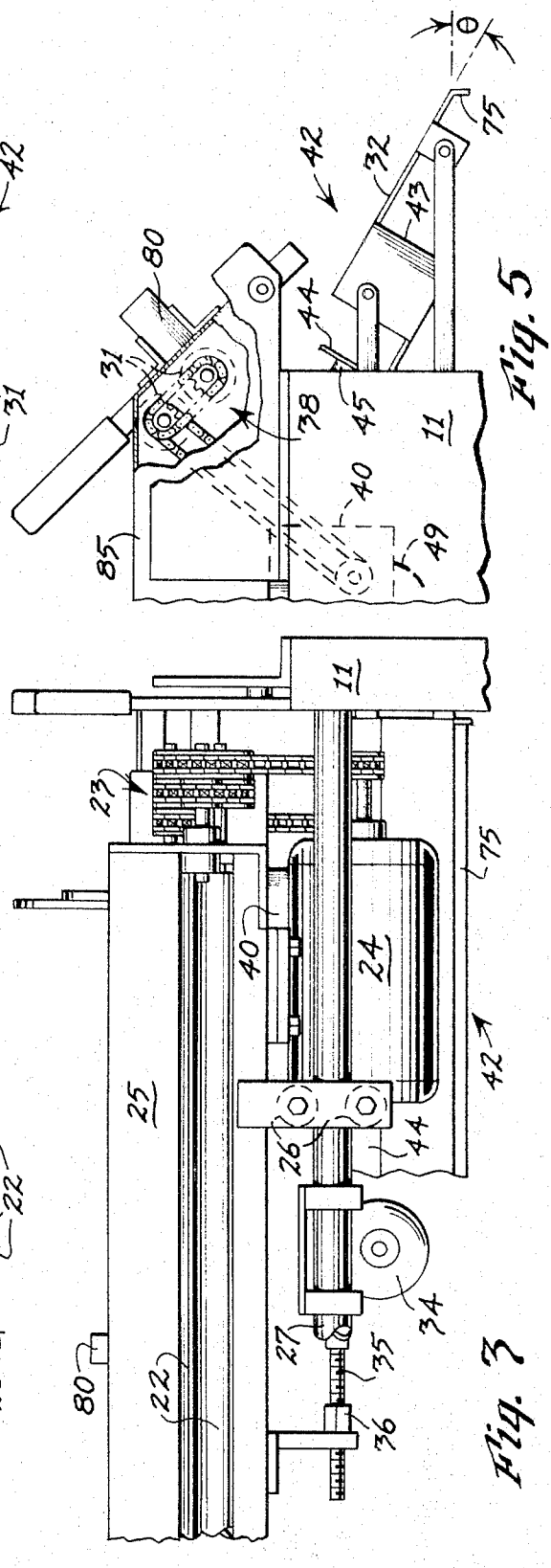

Fig. 3

Fig. 5

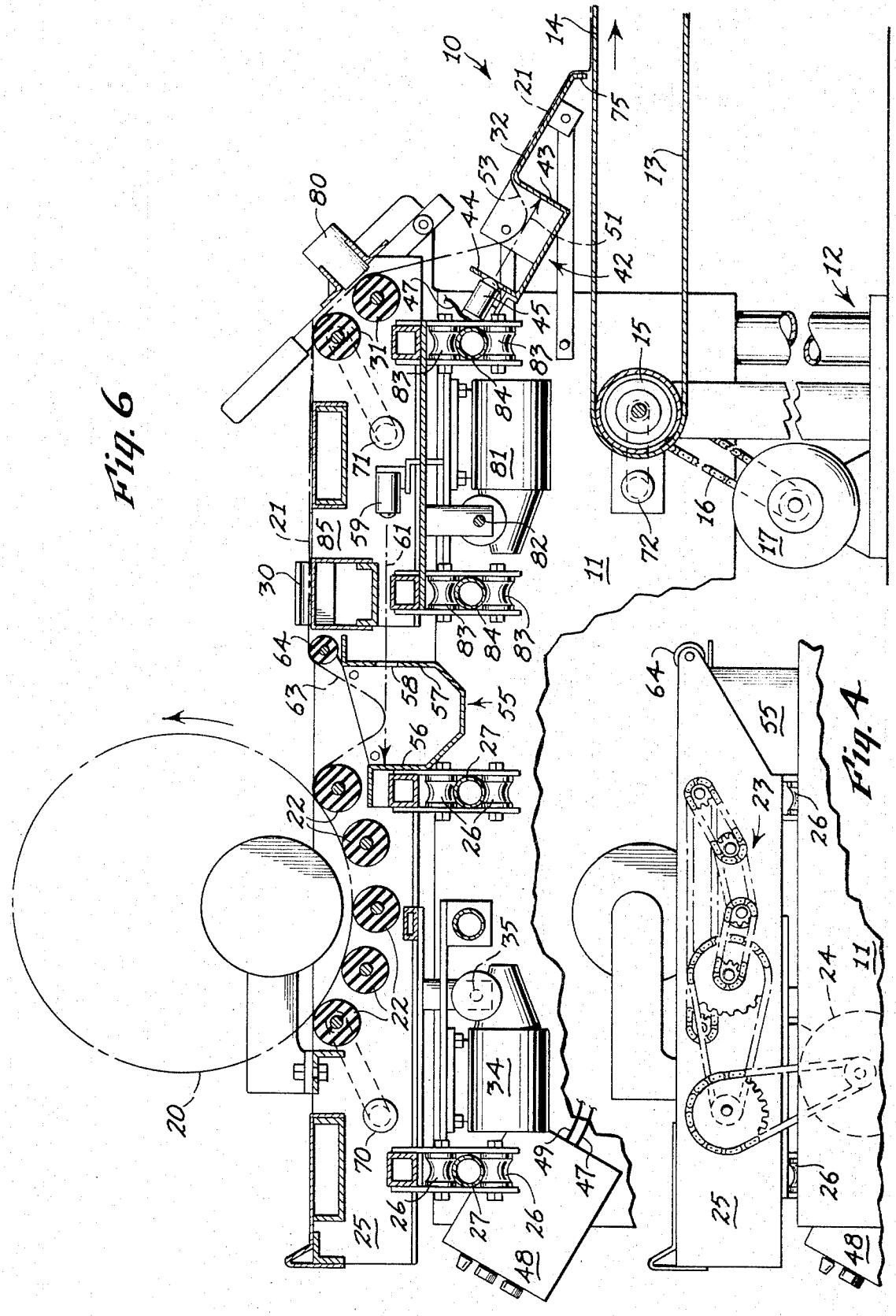

Fig. 6

Fig. 4

TENSIONLESS CLOTH FEEDING APPARATUS FOR CLOTH SPREADING MACHINE

BACKGROUND OF THE INVENTION

This invention relates to cloth spreading machines, and more particularly to the sensing and controlling of tension in the cloth fed by a cloth spreading machine to a cloth laying surface.

Cloth spreading machines of the type which move reciprocably longitudinally over a cloth spreading table for spreading layers of cloth upon the table are well-known in the art.

In recent months, GENESCO, INC. has had developed, and has been commercially using, a laser-type cloth cutting apparatus, which is adapted to cut with great accuracy and speed patterns in single layers of cloth, for the manufacture of apparel. The cloth is fed beneath the laser cutting apparatus upon a movable laying surface in the form of an endless conveyor belt. The cloth is supplied to the conveyor belt by a cloth spreading machine which is mounted upon a stationary support, as opposed to the conventional movable or traveling cloth spreading machine. The stationary cloth spreading machine has some functional similarities to the conventional traveling cloth spreading machine, in that it has a cloth supply in the form of a roll, preferably driven, to unwind the web of cloth from the roll, edge sensing mechanism for maintaining the longitudinal alignment of the cloth, positive cloth feed drive rolls, a stripe alignment sensing mechanism, and a spreader element for leading the cloth from the spreading machine and depositing it closely adjacent to the horizontally movable conveyor belt surface.

Because of the extreme accuracy of the laser cutting apparatus, the cloth must be laid upon the movable surface as uniformly "tensionless" as possible, so that when the pattern is cut by the laser apparatus, the cloth is smooth, free of wrinkles and taut. The "tensionless" spreading becomes particu-larly important in patterned cloth material, such as stripes, plaids and all other types of geometric and non-geometric designs. In other words, the cloth must be as relaxed before it is cut as it is after it is cut, to retain its dimensional stability.

There are many types of sensing devices for sensing the slack and tension in cloth, such as dancer rollers, feeler fingers and other types of mechanical elements which physically engage the cloth, and which are adapted to yield under the pressure of the cloth where excessive tension is experienced, to actuate a switch or other sensing device in order to control the stopping or starting or the speed of the drive feed rollers for correcting the sensed condition. However, because these mechanical sensing elements actually touch the cloth, sufficient friction or drag is imposed upon the cloth to establish errors which defeat "tensionless" feeding.

SUMMARY OF THE INVENTION

It is therefore an object of this invention to provide in a cloth spreading machine, a cloth feed control apparatus which substantially eliminates tension in the cloth spread upon the laying surface.

Another object of this invention is to provide in a cloth spreading machine a radiant energy sensing element for sensing excessive tension, or a predetermined slack, in the cloth fed by the spreading machine, without touching the cloth.

Another object of this is to provide a cloth spreading machine having a radiant energy sensing means and a cloth feed means which will maintain a slack loop in the cloth so that the cloth spread upon the laying surface is under minimum tension.

Another object of this invention is to provide a cloth spreading machine having sensing and cloth feed means for maintaining a constant slack loop in the cloth immediately beyind the spreader element, and a forwardly declining ramp or spreader element having a low-friction surface in which the friction of the ramp is substantially neutralized by the vector component of the weight of the cloth on the ramp, so that the cloth is laid upon the laying surface almost perfectly tension-free.

The spreading machine made in accordance with this invention is preferably stationary for spreading cloth upon a horizontally movable conveyor belt laying surface driven to move away from the stationary frame. A smooth, low-friction spreader element or ramp is mounted on the front of the spreader frame to decline forward terminating closely adjacent the laying surface. A cloth supply means, such as a cloth roll mounted upon positively driven feed rollers is mounted on the frame for feeding the cloth from the supply means to the spreader ramp. Intermediate cloth feed drive rolls are provided on the front of the frame. An elongated sensing trough is mounted between the cloth feed drive rolls and the spreader ramp for receiving a relaxed loop of cloth. A radiant energy sensing means, such as a lighted photoelectric cell is provided in the trough for creating a sensing beam for interception by the loop when excessive slack is developed in the loop. The sensing means controls the driving of the cloth feed rollers.

Where the machine includes an edge sensing device for regulating the cloth supply mounted on a laterally shiftable carriage, a second sensing station is provided between the edge sensing device and the cloth supply means. The second sensing beam operatively controls the supply feed drive means.

Preferably, the cloth supply feed control means, the cloth feed drive means and the means for driving the conveyor belt laying surface are synchronized to further refine the tensionless cloth feeding.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a fragmentary top plan view, with portions broken away, disclosing the right hand portion of the cloth spreading apparatus made in accordance with this invention;

FIG. 2 is a view similar to FIG. 1 disclosing the left hand portion of the cloth spreading apparatus;

FIG. 3 is a right rear end elevation of the apparatus;

FIG. 4 is a reduced fragmentary right side elevation of the rear portion of the cloth spreading machine;

FIG. 5 is a reduced fragmentary right side elevation, with portions broken away, of the front portion of the cloth spreading machine; and

FIG. 6 is a section taken along the line 6—6 of FIG. 1.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawings in more detail, the cloth spreading apparatus 10 made in accordance with this invention includes a spreader frame 11 mounted on

a stationary suport 12. Mounted adjacent the front of the stationary frame 11 is a horizontally movable endless conveyor belt 13, the top leg of which forms the laying surface 14 adapted to be moved forward longitudinally away from the front of the spreader frame 11, as indicated by the arrow in FIG. 6. The conveyor belt 13 may be supported by drum 15 driven through chain transmission 16 from electric motor 17.

Supported on the rear portion of the frame 11 is a cloth supply roll 20, from which a web of cloth 21 is unwound and fed forward. As illustrated, the supply roll 20 is supported upon an arcuate cradle of live or driven supply feed rollers 22. The supply feed rollers 22 are driven through a sprocket and chain transmission 23 from electrical supply motor 24.

The live supply rollers 22, transmission 23 and motor 24 are mounted upon a supply carriage 25 supported on rollers 26 for lateral shifting on transverse rails 27 fixed to the spreader frame 11.

The web 21 is fed from the supply roll 20 through an edge sensor device 30, if desired, and then over a cloth feed drive such as the driven cloth feed rollers 31. As disclosed in FIG. 6, the web 21 merely rests upon the upper surfaces of the cloth feed rollers 31, for light frictional engagement, as opposed to wrapping engagement so prevalent in conventional cloth spreading machines. This light feeding contact further minimizes tension in the cloth web 21. The web 21 is positively fed forward by the feed rollers 31 across a spreader element 32, where the cloth 21 is deposited upon the forward moving laying surafce 14.

When the edge sensing device 30 is employed, it senses the edge of the cloth web 21 and is electrically connected through controls to shifting, reversible electric motor 34 adapted to rotate the threaded drive shaft 35 connected to threaded coupling 34 on the shiftable carriage 25.

The cloth feed rollers 31 are driven through sprocket and chain transmission 38 by drive motor 40.

The spreader element 32 is preferably a ramp having a smooth, flat, low-friction, upper surface declining forward at an angle θ to the horizontal. The angle of the ramp 32 depends upon the coefficient of friction of its upper surface, and is selected to permit the cloth web 21 to slide fairly freely and without tension across the spreader ramp 21 until it is deposited upon the movable laying surface 14.

The cloth feed drive motor 40 is preferably designed to drive the cloth feed roll surfaces 31 faster than the speed of the laying surface 14, in order to produce slack between the cloth feed rollers 31 and the cloth web 21 laid on the moving laying surface 14.

Mounted immediately behind the spreader element 32 in a sensing trough 42 having a front wall 43 with a highly reflective interior face, and a rear wall 44. Mounted in the rear wall 44 is a radiant energy sensing element, such as a light emitter or lamp 45 and a light receiver or photoelectric cell 46. The lamp 45 is positioned to direct an incident light beam 51 through rear wall 44 against a point on the reflective surface of the front wall 43, so that the reflected beam 52 will be received by the photocell 46, as illustrated in FIGS. 1 and 6. The lamp 45 and photocell 46 are connected through electrical leads 47 to a control box 48, which is in turn connected through electrical leads 49 to cloth feed motor 40. Thus the light beam or beams 51 and 52 provide a limit or barrier which will intercept the slack loop 53 formed in the cloth web 21 by the overfeeding of the cloth feed rolls 31. When the cloth loop 53 breaks either beam 51 or 52, a signal is transmitted through the controls 48 to de-energize and stop the cloth feed motor 40. However, as soon as the cloth loop 53 rises above the beams 51 and 52 to reinstate the beams 51 and 52, a sensing signal is received at the control box 48 to re-energize and restart the cloth feed drive motor 40 and thereby start driving the cloth feed rolls 31 again.

In this manner, the cloth web portion between the cloth feed rolls 41 and the cloth laying surface 14 is almost in a tensionless state, with slack constantly maintained by the sensing elements 45 and 46. Because of the slack in the cloth, between the cloth feed rolls 31 and the moving cloth laying surface 14, this portion of the cloth is pulled effortlessly over the low-friction top surface of the declining ramp 32 by the portion of the cloth web already spread upon the laying surface 14, which is moving away from the spreader frame 11.

If desired, a second sensing trough 55 having a rear wall with a highly reflective face 56, and a front wall 57, may be mounted upon the frame 11 between the supply carriage 25 and the edge sensing device 30. Mounted on the frame 11 to shine through a corresponding opening 58 in the front wall 57 is a light 59 and a photocell 60 arranged in a manner similar to the lamp 45 and photocell 46 in the front trough 42. The beams 61 and 62 also function as a lower barrier to a loop 63 formed by the slack in the cloth web 21 between the supply cradle rollers 22 and guide roller 64 immediately behind the edge sensor 30.

Here again, the supply feed rollers 22 are preferably designed to feed the web 21 from the cloth supply roll 20 at a slightly faster speed than the cloth web 21 is fed by the cloth feed rollers 31, in order to maintain the slack loop 63. When the slack loop 62 depends below the barrier created by the rays 61 and 62, the photocell 60 transmits a signal through the lead 65 to the control box 48, which in turn transmits a signal through appropriate circuitry and lead 66 to supply motor 24, to de-energize the supply motor 24 and thereby stop the supply feed rollers 22. As the loop 63 is raised above the beams 61 and 62, sensing signal from the photocell 60 is transmitted to the control box 48 to restart the motor 24 and thereby start driving the supply roll 20 again through the supply rollers 22.

If desired, the supply motor 24, cloth feed motor 40 and the fabric surface drive motor 17 may be synchronized through corresponding tachometers 70, 71 and 72, which in turn may be connected to a common control mechanism in the control box 48 or to a separate control system.

In a preferred form of the apparatus 10, the edge sensing device 30 and the cloth feed rollers 31 are supported on a transversely or laterally shiftable front carriage 85. Rollers 83 mounted on the carriage 85 ride on transverse rails 84 fixed to the frame 11. A stripe sensing or alignment head 80, similar to that disclosed in U.S. Pat. No. 3,627,301, is preferably mounted on the front portion of frame 11, as shown in FIG. 6, to view and sense the stripes or lines in a patterned web 21. The sensing head 80 is electrically coupled to front shift motor 81 to reversibly drive threaded shaft 82 in threaded coupling block 82' fixed to front carriage 85 to laterally shift the front carriage 85 in order to maintain stripe alignment in the cloth 21.

It will be noted that the sensing trough 42 is strategicaly located between the front shiftable carriage 85 and the fixed spreader element 32, while the sensing trough is located between the front shiftable carriage 85 and the shiftable supply carriage 25. Thus tension and slack in the web 21 is sensed at the locations where lateral deviations are most likely to occur, between the relatively laterally movable structures supporting the cloth feed.

It will thus been seen that by sensing the cloth web 21 in this manner, the web is maintained virtually tensionless throughout its travel from supply roll 20 until it is spread or laid upon the laying surface 14. Reduction in cloth tension is further improved by the fact that the loops 53 and 63 hang freely within their respective troughs 42 and 55 with no exertion upon them except by the respective driven rollers 22, 31, and the almost frictionless bearing upon the spreader element 32. None of the sensing elements 45, 46, 59 and 60, physically touch the cloth loops 53 and 63 in any manner which would create any friction upon the cloth while the loops 53 and 63 are being detected or sensed for tension and slackness.

It will be understood that any other type of radiant energy than light, and any other radiant energy emitters and receivers than the lamps 45 and 59 and the photoelectric cells 46 and 60, may be employed.

Furthermore, because the cloth spreading frame 11 is stationary, no wind is produced by the spreader frame 11 during the spreading operation, which might affect or blow the loop 53 and 63 against other parts of the frame or the troughs 42 and 55 to create any frictional engagement between any parts of the machine and the floating loops 53 and 63. Such wind would be created if the spreading machine were moving over a station-ary cloth laying surface, as in conventional cloth spreading machines.

The front edge of the spreader ramp 32 is provided with a depending lip 75 to prevent the cloth web 21 from feeding or creasing rearward beneath the ramp 32 for any reason, such as inertia created by the momentum of the cloth 21 feeding over the ramp 32 upon a sudden stop in the movement of the conveyor belt surface 14.

What is claimed is:

1. A cloth spreading machine comprising:
   a. a spreader frame,
   b. a cloth laying surface having a longitudinal direction,
   c. means for relatively moving said laying surface and said spreader frame longitudinally,
   d. a spreader element mounted on said spreader frame adjacent said laying surface,
   e. cloth supply means on said spreader frame,
   f. feed means on said frame for feeding cloth from said supply means to said spreader element,
   g. means for driving said relatively moving means so that said laying surface and said spreader frame move relatively away from each other longitudinally in a spreading mode,
   h. means for normally driving said feed means to feed cloth at a speed faster than the relative speed of said laying surface and said spreader frame in said spreading mode,
   i. a sensing station on said frame in the path of said cloth between said feed means and said laying surface,
   j. radiant energy sensing means at said sensing station for sensing a slack portion of cloth,
   k. control means operatively connecting said radiant energy sensing means to said feed drive means to actuate said drive means to feed cloth when said sensing means senses a predetermined tension in said slack cloth portion, and to de-actuate said feed drive means when said sensing means senses excessive slack in said cloth portion.

2. The invention according to claim 1 in which said spreader frame is stationary and said cloth laying surface is movable.

3. The invention according to claim 2 in which said cloth laying surface is an endless conveyor belt member.

4. The invention according to claim 1 in which said spreader element comprises a ramp extending transversely of said frame and declining from said frame toward said laying surface, said ramp having a low-friction surface over which said cloth is pulled by the relative movement of said laying surface away from said frame, said sensing station being between said feed means and said ramp.

5. The invention according to claim 4 in which the angle of declination of said ramp is a function of the coefficient of friction of said ramp surface and the weight of the cloth fed over said ramp.

6. The invention according to claim 4 further comprising a transverse sensing trough at said sensing station, said sensing means comprising a radiant energy emitter and a radiant energy receiver in said trough for creating a radiant energy beam across said trough for interception of a cloth loop.

7. The invention according to claim 6 in which said emitter and said receiver are mounted in one wall of said trough, the opposite wall of said trough constituting a highly reflective surface for reflecting the emitted energy beam to said receiver.

8. The invention according to claim 1 in which said feed means is between said supply means and said sensing station and proximate to said sensing station, said supply means comprising positive feed means for feeding said cloth from said supply means, and means for driving said supply feed means.

9. The invention according to claim 8 further comprising a second sensing station between said supply means and said cloth feed means, second radiant energy sensing means at said second sensing station for sensing a second slack portion of cloth, second control means operatively connecting said second radiant energy sensing means to said cloth supply feed drive means to actuate said supply drive means to feed cloth when said second sensing means senses a predetermined tension in the second slack portion at said second station, and to de-actuate said supply feed drive means when said second sensing means senses excessive slack in the second slack portion at said second station.

10. The invention according to claim 9 further comprising synchronous control means operatively connecting said first control means, said second control means and the means for driving said relatively moving means, to synchronize the operation of said relatively moving means, said cloth feed means and said supply feed means to spread cloth upon said laying surface with a minimum of tension.

11. The invention according to claim 9 further comprising a first carriage supporting said supply means for lateral shiftable movement upon said frame.

12. The invention according to claim 11 further comprising a second carriage supporting said cloth feed means for lateral shiftable movement upon said frame, said first sensing station being between said second carriage and said spreader element, and said second sensing station being between said first carriage and said second carriage.

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